INTEGRA MICROWAVE

MODEL NF-226

NOISE FILTER

OPERATION & SERVICE MANUAL

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WARRANTY

Integra warrants this instrument to be free from defects in material and workmanship for one year from the date of delivery. Damage due to accident, abuse or improper operation, is not covered by the warranty. Removal, defacement, or alteration of any serial or inspection label, marking or seal, may void the warranty. Integra will repair or replace at its option, any components of this instrument which prove to be defective during the warranty period, provided the entire instrument is returned prepaid to Integra or its authorized service facility.

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1.0 GENERAL INFORMATION

1.1 Introduction

The Model NF-226 NOISE FILTER provides a new measurement and production test capability not previously available in an instrument for noise figure measurement.

The NF-226 NOISE FILTER, is a WIDEBAND YIG FILTER which can be electronically tuned over the entire range of 2 to 26.5 GHz by means of an externally applied positive DC voltage or by way of the 488 Bus. Two different drive sensitivity ranges are provided, .5 V/GHz (0 TO +10 V) and 1V/GHz (0 to 20V), selectable at the rear panel.

The key to the NF-226 performance is a three-pole yttrium-iron-garnet (YIG) filter designed for maximum tuning range and maximum bandwidth. The 3 dB bandwidth is nominally 25 to 90 MHz over the 2 to 26.5 GHz frequency range; selectivity is 18 dB/octave; off resonance isolation is typically greater than 40 dB; insertion loss less than 8 dB.

1.2 RF Filter Specifications	MODEL NF-226
Number of Stages	3
Frequency Range	2-26.5 GHz
Bandwidth (-3 dB)	25-90 MHz
Insertion Loss (max)	8 dB
Passband Ripple and Spurious (max)	2 dB
Off Resonance Isolation (ORI)	40 dB*
Limiting Level (min)	+10 dBm
Selectivity (nom)	18 dB/Octave
VSWR (typ)	2:1
Impedance (nom)	50 Ohms
Hysteresis (max)	10 MHz
Max. Input Power	+30 dBm
Connectors	SMA Jack (3mm)
Size (WxHxL), (excluding RF connectors)	2.75" x 3" x 3.25"

* ORI: >-40 dB to 5 GHz.

1.3 Control Unit Specifications

Frequency Accuracy.....	0.1% ± 10 MHz
Frequency Resetability.....	<10 MHz
Operationg Modes:	
CW or Sweep.....	Apply either a .5 V or 1 V/GHz analog voltage from signal generator to external input of NF-226
488.....	Command filter position with 488 Bus.
Temperature Range	10 to 50 degrees C
Control Unit Size (WxHxD)	8 1/2" x 5 1/4" x 17"
AC - Power	115/230 VAC, 50/60 Hz, 50 Watts max.

1.4 IEEE-488 Control Specification

COMMAND FORMAT: DDDDABC

"DDDD" = Frequency Selection Information

	STANDARD
# of discret codes	65535 for 0 to 26500 MHz
Code Sensitivity (MHz/Code)	0.40436 MHz/Code
Calculation Code	DECIMAL (then translated to HEX)
Lowest Code in HEX	0000
Highest Code in HEX	FFFF
Leading Zeros Req. In Transmission Code	Yes
Transmission Code	HEX-Code translated to Transmission - Code per Table 2-1.

2.0 OPERATION

2.1 GENERAL

The NOISE FILTER is a versatile, wide frequency range laboratory instrument that can conveniently separate or isolate signals on the basis of frequency. The RF-Head contains a 3 stage yitrium-iron-garnet (YIG) filter that can be remotely located from the Control Unit.

2.2 FRONT PANEL FEATURES

FIGURE 1 illustrates the front panel controls.

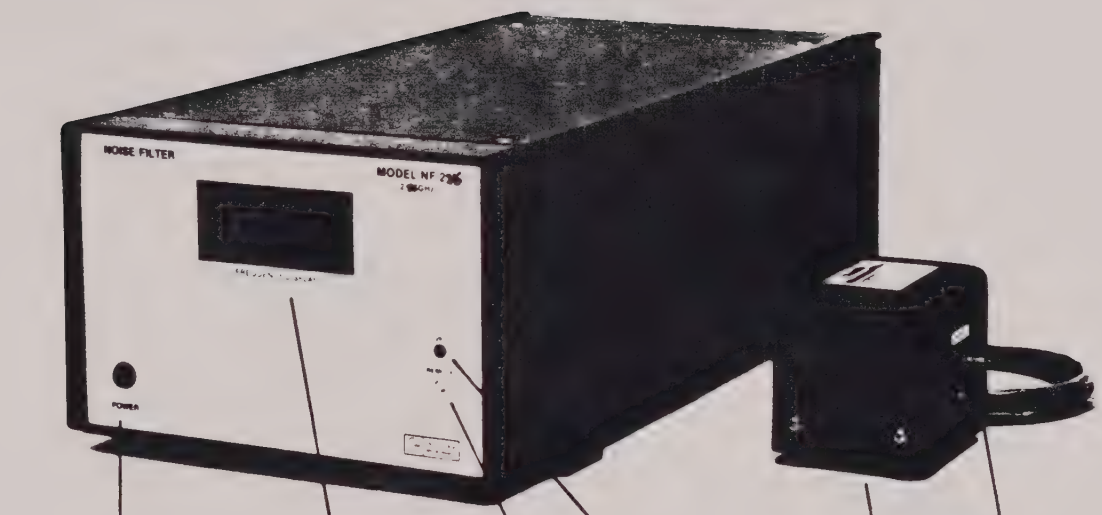
POWER: When AC power is applied to the instrument and the power switch depressed, the power indicator (GREEN LED) will be illuminated.

REMOTE: When the instrument is under 488 control the remote indicator will be illuminated (YELLOW LED).

+28V: When the indicator (RED LED) is illuminated the +28V supply is turned on.

FREQ DISPLAY:

The Frequency Display indicates the tuned frequency of the YIG Filter in GHz.



POWER
ON-OFF SWITCH

FREQUENCY DISPLAY
(GHz)

REMOTE INDICATOR

+28V ON INDICATOR

RF FILTER

CONNECTOR SAVERS
ON INPUT AND OUTPUT
ON FILTER
(FIELD REPLACEABLE)

FIGURE 1 FRONT PANEL

2.3 REAR PANEL FEATURES

FIGURE 2 illustrates the rear panel connections and controls.

AC POWER INPUT & FUSE HOLDER

For 115 VAC 50/60 Hz operation, use a 1A, Slow-Blow fuse. For 230 VAC operation, use a 1/2 A, Slow-Blow fuse.

FILTER CONNECTOR

This is the RF-Filter control output connector. Use only the control cable supplied with the instrument.

EXTERNAL DRIVE SELECT

Selector switch for 0.5 V/GHz (drive to 26.5GHz) or 1 V/GHz (drive to 20GHz) input drive sensitivity.

EXT. DRIVE INPUT

An external analog drive voltage of +1 to 13.25 V (in 0.5 V/GHz mode) or 2.0 to +20.0 V (in 1 V/GHz mode, 20GHz max) sweeps the filter over the frequency range.

DRIVE OUTPUT

An analog output voltage, proportional to the input drive is provided.

IEEE-488 BUS CONNECTOR

A standard IEEE-488 Bus connector is provided for Bus Control.

ADDRESS SWITCH

The address switch allows setting of the desired address for the IEEE-488 Bus control.

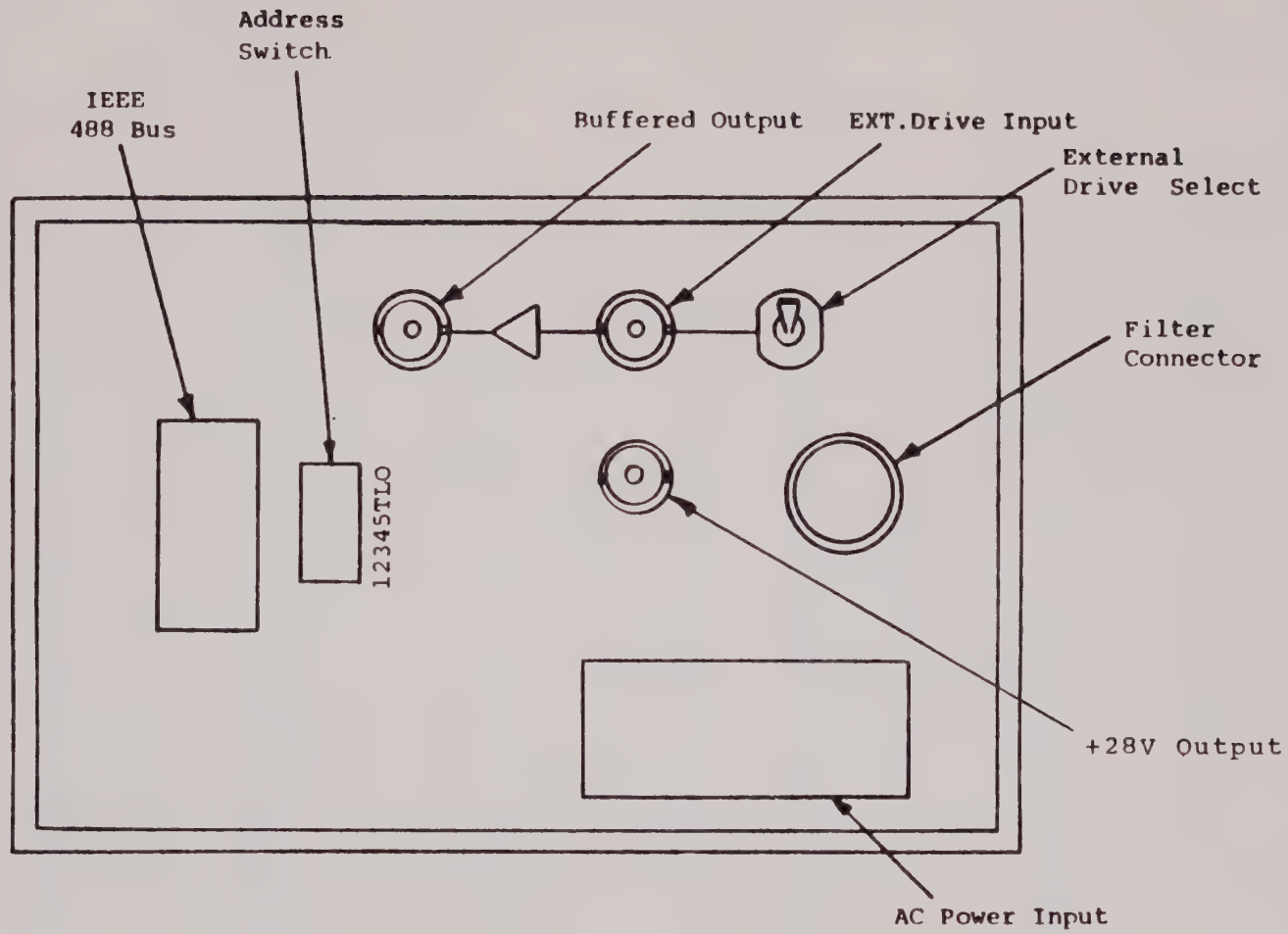


FIGURE 2 REAR PANEL

2.4 IEEE-488 CODES

The NF-226 can be controlled over the IEEE-488 bus. The programmable functions are:

1.) Frequency of filters
2.) Offset mode (positive or negative)
3.) + 28 V Power Supply for the noise source

2.4.1 REMOTE PROGRAMMING INSTRUCTIONS

2.4.1.1 The 488 Bus uses two modes to communicate between instruments: Command Mode and Data Mode. To control any instrument on the Bus the Command must preceed the Data. See figure 2-1.

OUTPUT 705;"DD...D"
COMMAND DATA

During the Command Mode, the system controller addresses the instrument to be programmed. During the Data Mode, instructions and data are sent to the instrument.

2.4.1.2 The typical system controller command structure for the HP-85 is:

Instrument address

OUTPUT 705;"0000000"

Selects output port of the HP-85 controller

The above statement sends data to the instrument which has been preset to address "05".

2.4.2 CODE SELECTION FOR HP-85 CONTROLLER

2.4.2.1 The remote control of the filter frequency has 65536 steps or points of resolution which must be converted into meaningful code. The process by which IEEE-488 code is generated is graphically depicted in Diagram 2-2. Following is an explanation of the 3 sections of the diagram:

A. CONVERT DESIRED FREQUENCY TO DECIMAL FORMAT

PARAMETERS: I3 = DESIRED FREQUENCY (MHz)
I4 = calculation variable

General Equation:

$$I4 = \text{INT}\left[\frac{65535 * (I3)}{26500}\right]$$

I4 is a decimal number which represents the code for the desired frequency.

B. DECIMAL TO HEX CONVERSION

Since the 488-system in the unit uses 16 Bit binary it is necessary to convert the decimal number into Hex-Code. The I/O ROM in the JP-85 allows base conversion functions but because of the string size restriction, the string has to be divided for conversion.

I5 = INT (I4/256)		Integer representing first 2 characters of final 4 - character string.
I6 = I4 - (I5 * 256)		Integer representing last 2 characters of final 4 - character string.
I5$ = DTH$(I5)		Decimal to hex conversion
I5$ = I5$[3,4]		Select substring (3rd and 4th character of string)
I6$ = DTH$(I6)		Decimal to hex conversion
I6$ = I6$[3,4]		Select substring (3rd and 4th character of string)
I7$ I5$ & I6$		Assemble final hex string

C. CONVERT HEX-TUNING CODE TO TRANSMISSION CODE

The HEX-code can be converted to Transmission code with the "CONVERT" command of the HP-85 - I/O ROM. See Table 2-3 for the allowable Transmission Code (DATA).

P1$ = " A : B ; C < D = E > F ? "	P1$ represents the conversion table.
CONVERT out 7 pairs ; P1$	Convert statement acts on interface at select code 7 and uses P1$ conversion table.
OUTPUT 705 ; I7$	Regular output statement to send data I7$ to address 05
CONVERT out 7	Turns off the convert function.

After the completion of step "C" in the conversion process I7$ contains the proper frequency information made up of 4 data characters "DDDD".

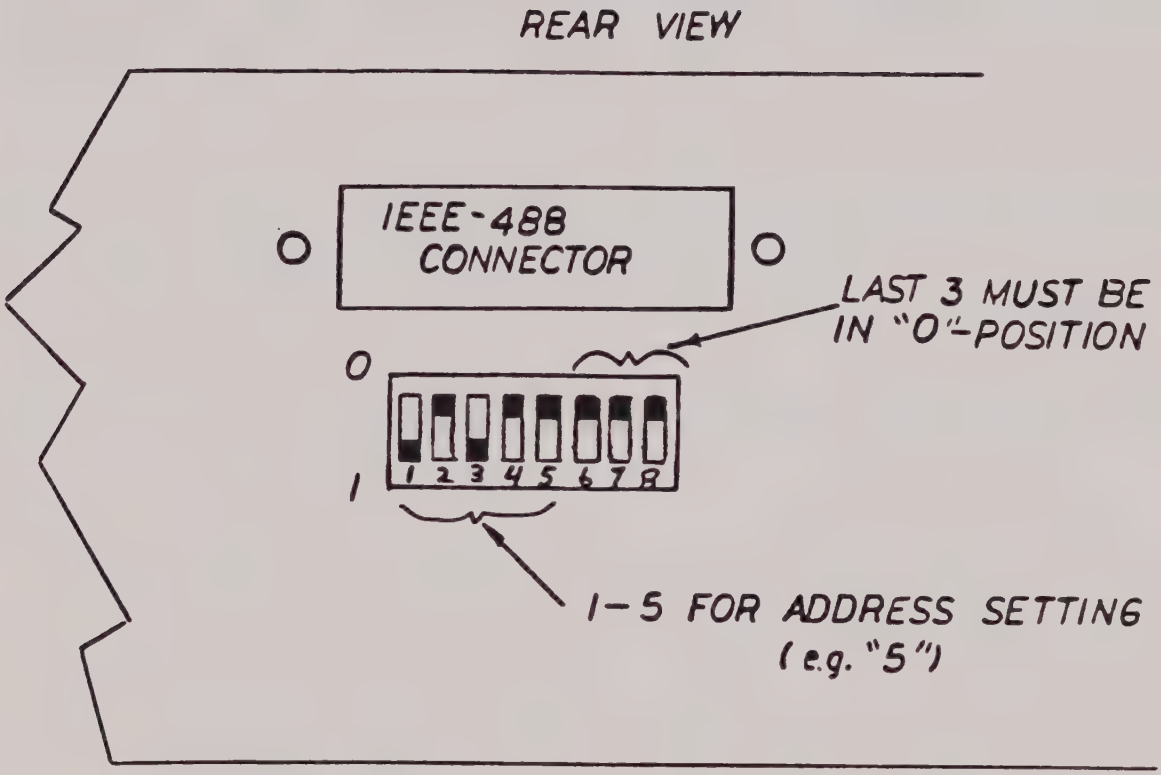


FIGURE 2-1 BUS CONNECTION

2.4.3 ALLOWABLE INSTRUMENT CODES FOR NF-226

The code required on the IEEE-488 Bus is a 7 charater string in the following form: "DDDDABC". If more than 7 characters are sent the instrument will ignore the remaining characters. (data reading is from left to right) The data code "DDDD" is explained in section 2.4.2.

A. POSITIVE FREQUENCY OFFSET

When "A" = 1, 3, 5, 7, or 9, ;, =, ?, then the positive frequency drive is selected. (Used for direct filter drive or for positive frequency offset). (When "A" = 0, 2, 4, 6, 8, :, <, >, then the drive is disabled).

B. NEGATIVE FREQUENCY OFFSET

WHEN "B" = 1, 3, 5, 7, or 9, ;, =, ?, then the negative frequency offset is selected. (Used with the analog input drive signal to set-up a negative offset (lower frequency). (When "B" = 0, 2, 4, 6, or 8, :, <, >, then the negative offset drive is disabled.

C. +28 V ON/OFF CONTROL

When "C" = 1, 3, 5, 7, or 9, ;, =, ?, then the +28V output is "ON".
When "C" = 0, 2, 4, 6, or 8, :, <, >, then the +28V output is "OFF".

Example

1. Tune filter with IEEE-488 Bus to 900 MHz and disable the +28V output.

   The set-up requires a few simple steps:

   a) Required frequency selection code is:

      In decimal Code:

$$I4 = \left(\frac{65535 * 15000\ (MHz)}{26500} \right) = 37095$$

      Converted into hex code gives 90E7

      Converted into transmission code give "90>7"

   b) The required control codes are:
      A = "1" selects positive drive.
      B = "0" disables negative offset.
      C = "0" disables +28V output.

   c) To drive the unit with an HP-85 controller and have the +28V output off, the command would be:

```
10 OUTPUT 705; "90>7100"
```

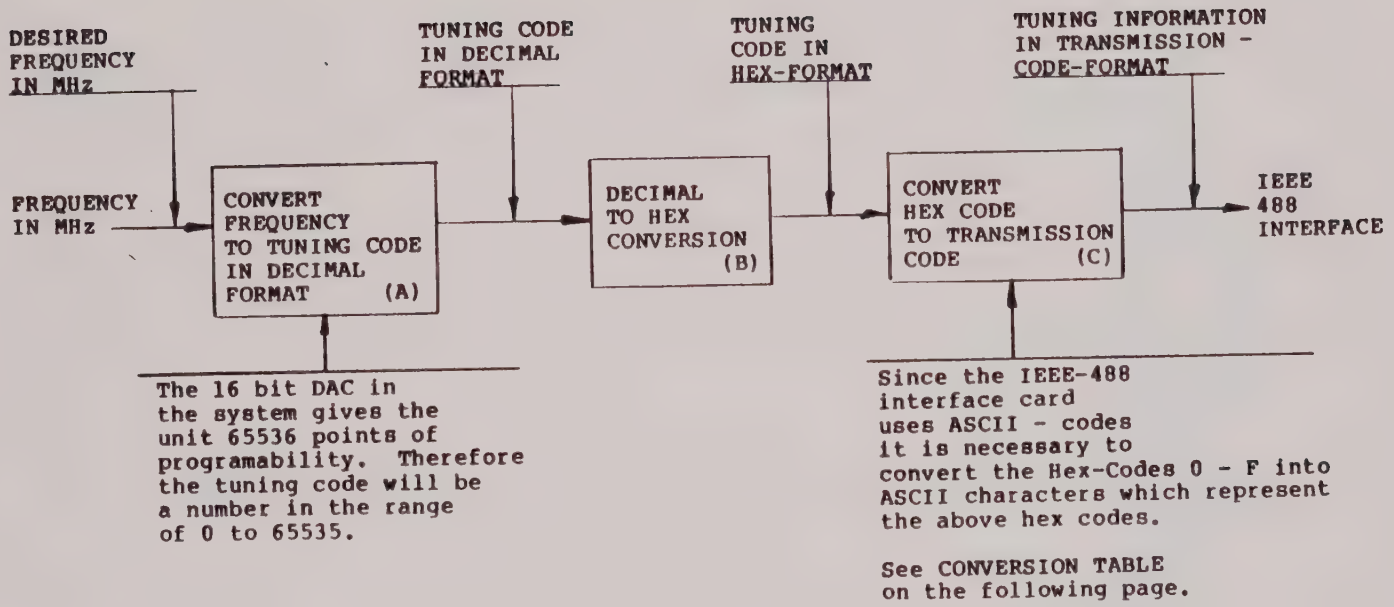

DESIRED FREQUENCY IN MHz
FREQUENCY IN MHz
CONVERT FREQUENCY TO TUNING CODE IN DECIMAL FORMAT (A)
TUNING CODE IN DECIMAL FORMAT
DECIMAL TO HEX CONVERSION (B)
TUNING CODE IN HEX-FORMAT
CONVERT HEX CODE TO TRANSMISSION CODE (C)
TUNING INFORMATION IN TRANSMISSION - CODE-FORMAT
IEEE 488 INTERFACE
The 16 bit DAC in the system gives the unit 65536 points of programability. Therefore the tuning code will be a number in the range of 0 to 65535.
Since the IEEE-488 interface card uses ASCII - codes it is necessary to convert the Hex-Codes 0 - F into ASCII characters which represent the above hex codes.
See CONVERSION TABLE on the following page.

DIAGRAM 2-2 CODE SELECTION PROCESS

CONVERSION TABLE

HEX-CODE	TRANSMISSION CODE
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
A	:
B	;
C	<
D	=
E	>
F	?

TABLE 2-3 TRANSMISSION CODE

2.4.4 LISTEN ADDRESS CODES

In a 488 system, the NF-226 functions as a Listener. A Listener is a device capable only of receiving data or commands from other instruments. The NF-226 is enabled as a listener when the controller transmits the correct listen address code. The NF-226 interface ignores all commands or addresses relating to talkers or controllers.

The seven-bit codes reserved for listen addresses and the corresponding ASCII character are listed in Figure 4. (A total of 31 addresses are available) Bits one through five of the data (DIO) lines are set either high or low to select the address. The address code is set with five address switches (Figure 1.1) on the rear panel. An open contact (off position) indicates a true state.

The nominal NF-226 listen address is ASCII Character "05". The address may be changed by the system designer since the NF-226 does not require any particular address. When changing addresses, be sure the new address does not conflict with those of other instruments using the 488 Bus (Refer to Figure 1.1).

After changing the address, turn unit OFF and ON again to properly initialize the 488-card.

Address Switch Numbers					Address Characters		Octal Value	Decimal Value
5	4	3	2	1	Talk	Listen		
0	0	0	0	0	@	SP	00	00
0	0	0	0	1	A	!	01	01
0	0	0	1	0	B	"	02	02
0	0	0	1	1	C	#	03	03
0	0	1	0	0	D	$	04	04
0	0	1	0	1	E	%	05	05
0	0	1	1	0	F	&	06	06
0	0	1	1	1	G	'	07	07
0	1	0	0	0	H	(	10	08
0	1	0	0	1	I	)	11	09
0	1	0	1	0	J	*	12	10
0	1	0	1	1	K	+	13	11
0	1	1	0	0	L	,	14	12
0	1	1	0	1	M	-	15	13
0	1	1	1	0	N	.	16	14
0	1	1	1	1	O	/	17	15
1	0	0	0	0	P	0	20	16
1	0	0	0	1	Q	1	21	17
1	0	0	1	0	R	2	22	18
1	0	0	1	1	S	3	23	19
1	0	1	0	0	T	4	24	20
1	0	1	0	1	U	5	25	21
1	0	1	1	0	V	6	26	22
1	0	1	1	1	W	7	27	23
1	1	0	0	0	X	8	30	24
1	1	0	0	1	Y	9	31	25
1	1	0	1	0	Z	:	32	26
1	1	0	1	1	[	;	33	27
1	1	1	0	0	\	<	34	28
1	1	1	0	1	]	=	35	29
1	1	1	1	0	^	}	36	30
1	1	1	1	1	_	?	37	31

FIGURE 4 IEEE-488 ADDRESS CODE

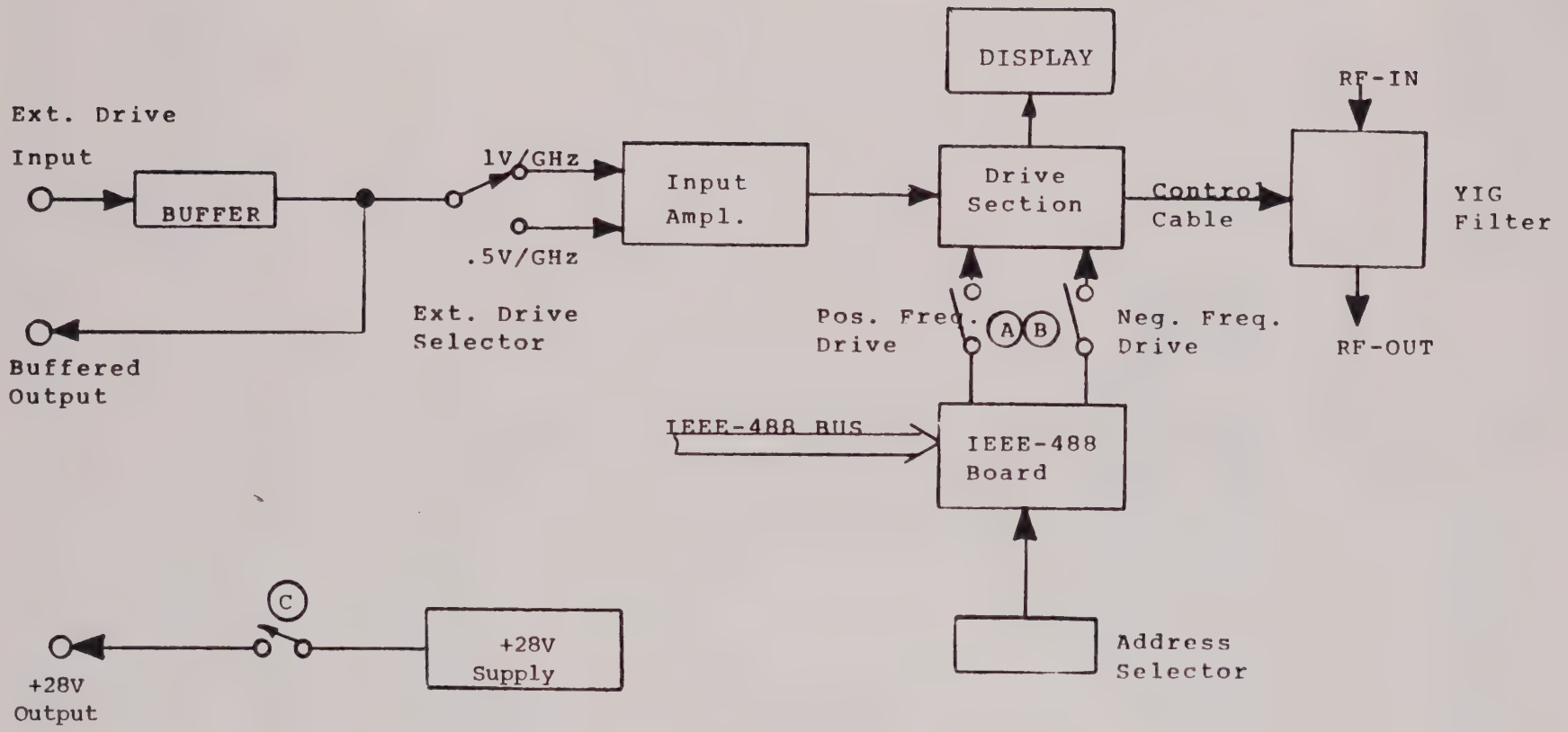


FIGURE 3 NF-226 BLOCK DIAGRAM

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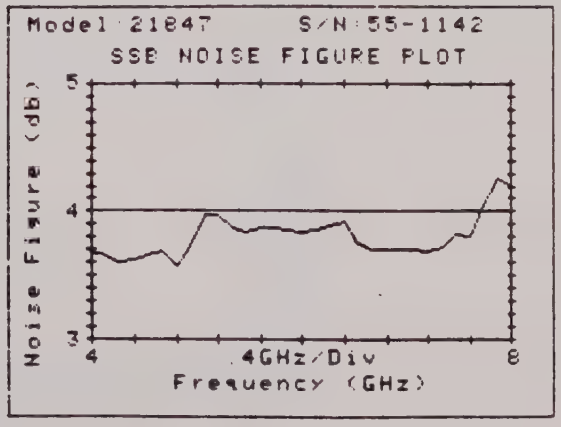
Product Note NF-218

Direct Noise Figure Measurement 2-18 GHZ

Single Sideband Noise Figure Plot



Microwave Measurement Techniques

LOW COST & ACCURATE
NOISE FIGURE MEASUREMENT
2-18 GHZ

INTRODUCTION

It's now possible to measure the noise figure of Wide Band Amplifiers, operating from 2 to 18 GHZ, without the use of an expensive downconverter. Integra Microwave's model NF-218 eliminates the need for a wide band mixer and L.O., and provides accurate single sideband noise figure data. There is NO image sideband or L.O. noise to influence measurement accuracy.

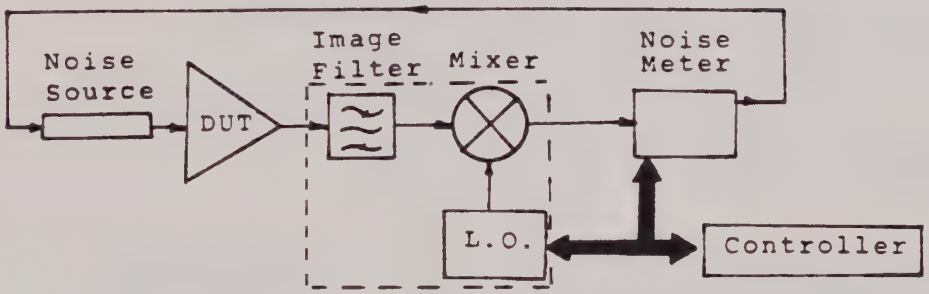


Figure 1

The DOWNCONVERTER method, illustrated in figure 1, requires a wide band mixer, GPIB signal generator and a filter to eliminate the image noise sideband.

The DIRECT method (figure 2) provides low cost, highly accurate noise figure measurements over the entire 2-18 GHZ frequency range.

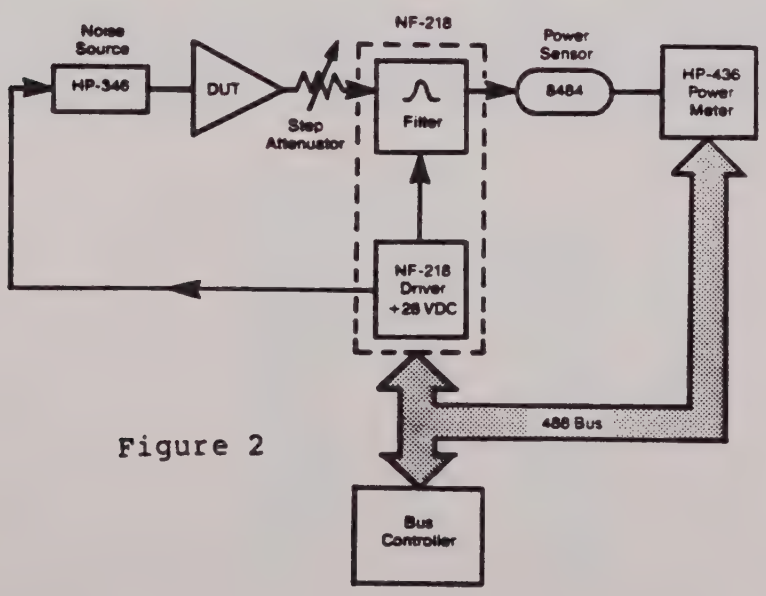


Figure 2

DIRECT METHOD

With todays computer controlled microwave instrumentation and a 2-18 GHZ Tunable Band-Pass Filter, it's possible to completely automate noise figure measurement using the Y-Factor method. This technique involves the determination of the numerical power ratio N2/N1 (which is called Y-Factor) and calculate noise figure using the following equation: (5)

$$F = ENR - 10 \log (Y-1)$$

The Y-Factor is the ratio of two power outputs from the device under test (DUT). (2)

$$Y = \frac{N2}{N1}$$

-N2 corresponds to the power reading with the noise source "ON".

-N1 corresponds to the power reading with the noise source "OFF".

-ENR is the excess noise ratio of the Noise Source (HP 346B), typically 15.2 dB.

"N" in Watts

$$F = ENR - 10 \log\left[\frac{N2}{N1} - 1\right]$$

"N" in dBm

$$F = ENR - 10\log\left(10^{\left(\frac{N2-N1}{10}\right)} - 1\right)$$

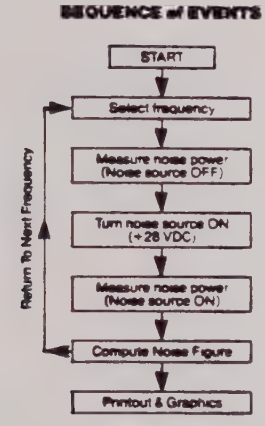
INTEGRA MICROWAVE'S Model NF-218 performs two functions. It's a GPIB tunable bandpass filter (2-18 GHZ) and bus controlled (ON/OFF) +28 volt power supply for the HP-346B noise source, or any other solid state noise source.

ACCURACY

Since the filter is used in a power ratio measurement of N2/N1 at each discrete frequency, its insertion loss and bandwidth variations do not influence the measurement accuracy. The noise figure accuracy is determined by the Noise Source's ENR accuracy.

DESCRIPTION

The noise figure measurement system shown in figure 2 works in principle like most noise figure meters. Once the NF-218 Filter is tuned to the measurement frequency, the +28 volts to the HP-346B Noise Source is turned ON and OFF by commands received by the NF-218 from the GPIB controller. The 436A Power Meter, with the 8484A Power Sensor, measures the output powers corresponding to the source ON and OFF (N2 & N1), and transmits these to the controller. The computer then calculates and displays the noise figure. (2)



The DUT and Post Amplifier must have sufficient gain so that the noise power levels into the HP-8484A Power Sensor are between -49 and -20 dBm (1,2). The NF-218 filter bandwidth is approximately 32 MHZ, requiring a net gain, between the noise source and power sensor, of 50 dB.

ERROR CORRECTION
• Use Correct ENR • Use Actual Tc • 2nd Stage Correction • Mismatch Uncertainly

ENR CORRECTION

By entering the Noise Source ENR data, the computer automatically corrects for noise source ENR variations. The ENR data supplied with the HP-346B is entered as a function of frequency.

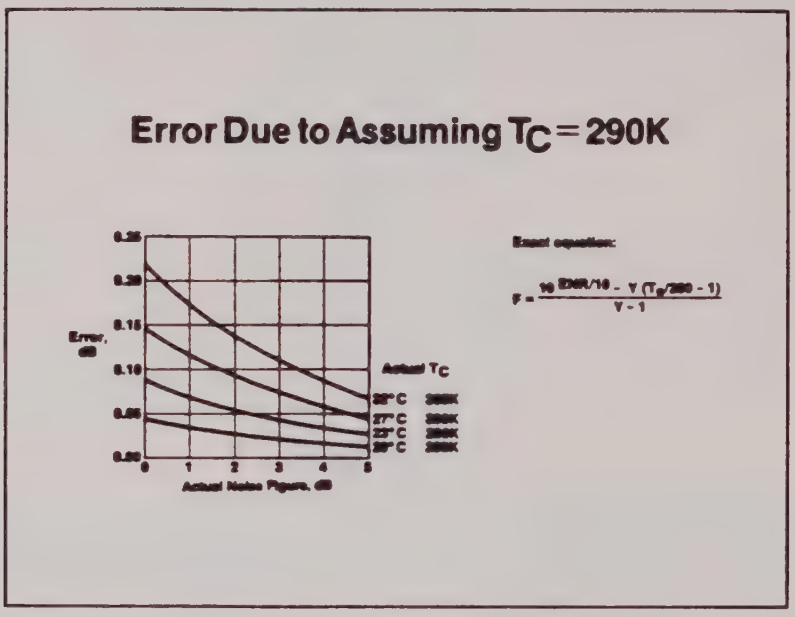
ENR-DATA IN MEMORY
HP346B-NOISE SOURCE
S/N: 2037A01547

FREQ (MHZ)	ENR
1000	15.41
2000	15.27
3000	15.05
4000	14.95
5000	14.96
6000	14.94
7000	14.97
8000	15.07
9000	15.12
10000	15.19
11000	15.25
12000	15.29
13000	15.23
14000	15.26
15000	15.29
16000	15.44
17000	15.64
18000	15.89

Tc CORRECTION

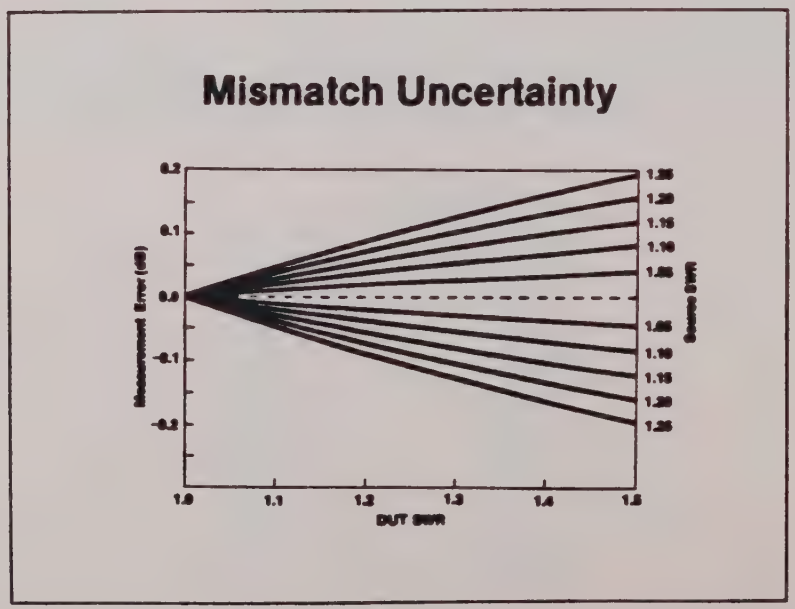
It is important to use the actual OFF temperature (Tc) of the noise source when calculating noise figure. The graph shows the error due to assuming that Tc is 290K.(3) By entering the actual Tc, the computer uses the "exact" noise figure equation and eliminates the Tc error.

For example, for Tc of 27°C the error is 0.1dB when measuring a 1.7dB noise figure.



MISMATCH UNCERTAINTY

The errors caused by mismatch can be kept to a minimum by using a noise source, such a the HP346B, that maintains a good match in both the ON and OFF state.



2nd STAGE CORRECTION

The Noise Figure of the second stage can be measured by reversing the position of the Post Amp and DUT. This procedure keeps the same overall gain for both the Post Amp and DUT noise figure measurements.

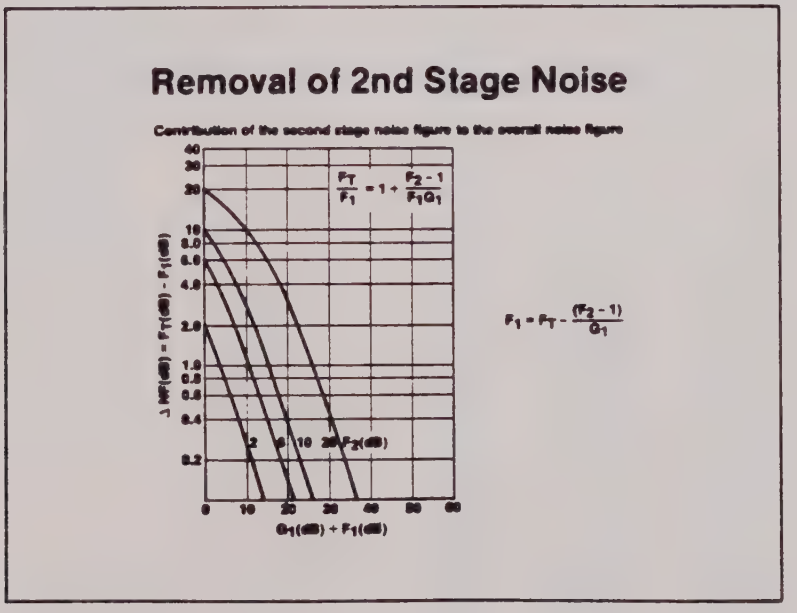
If the gain of the DUT is less tha 30 dB it may be necessary to correct for the post amplifier noise figure. Since the DUT gain and post amplifier (2nd Stage) noise figure have been determined, the DUT noise figure can be corrected using the equation below. This is included in the operating program.

The second stage error is: $\frac{(F2-1)}{Gd}$

F2 = Noise Figure of 2nd Stage
Gd = Gain of DUT
Fd = Noise figure DUT
Ft = Total Noise figure (DUT & Post AMP)

$$Fd = Ft - \frac{(F2-1)}{Gd}$$

$$Fd(db) = ENR - 10 \log\left[\left[\frac{N2}{N1} - 1\right] - \frac{(F2-1)}{Gd}\right]$$


Removal of 2nd Stage Noise
Contribution of the second stage noise figure to the overall noise figure
$\frac{F_T}{F_1} = 1 + \frac{F_2 - 1}{F_1 G_1}$
$F_1 = F_T - \frac{(F_2 - 1)}{G_1}$
$G_1(dB) + F_1(dB)$

For example, if a device with a noise figure, Fl, of 2dB and gain, Gl, of 18dB is measured with a system that has a noise figure, F2, of 10dB, the measured result, FT, will be too high by almost 0.4dB.

GAIN OF DUT

The following is a procedure for measuring gain of the Device Under Test (DUT).

1. Connect Noise Source to Post Amplifier

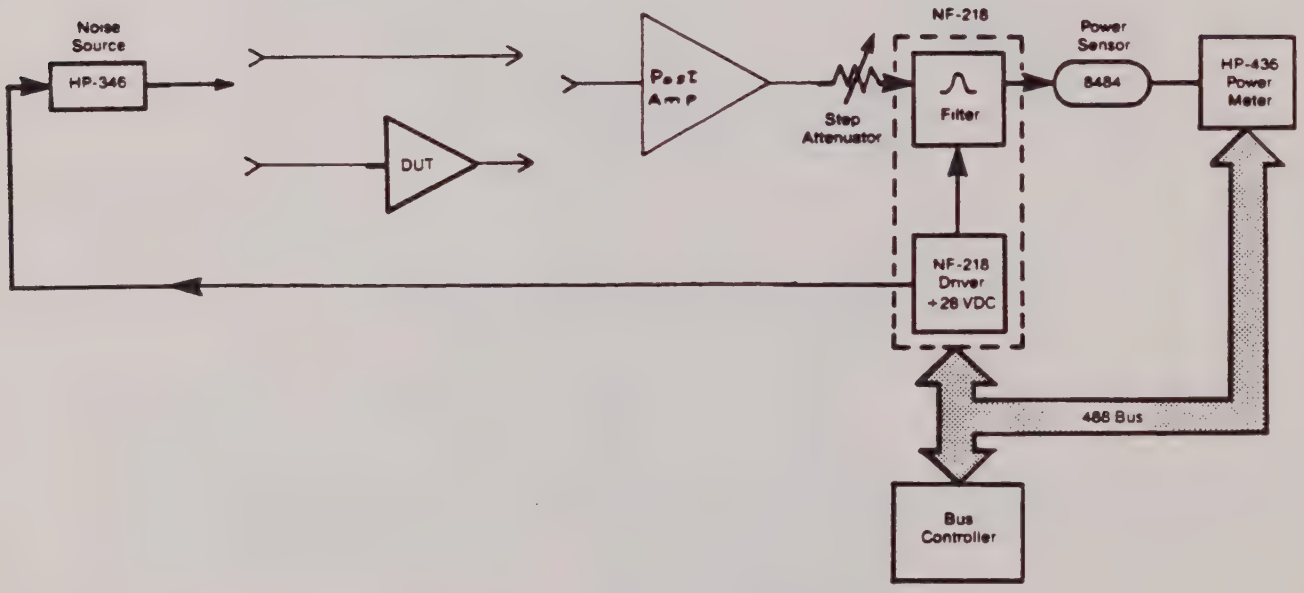
   Measure: N1'= Noise Source OFF
            N2'= Noise Source ON

2. Insert DUT

   Measure: N1 = Noise Source OFF
            N2 = Noise Source ON

3. Calculate Gd (Gain of DUT)

$$Gd = \frac{N2-N1}{N2'-N1'}$$



NF-218 TEST RESULTS

The noise figure of a 4-8 GHZ amplifier was measured using the DIRECT method, and the folling data was printed out by the HP-85 controller.

TEST EXAMPLE:

Wide Band Amplifier

Type: Multi Stage

Frequency: 4-8 GHZ

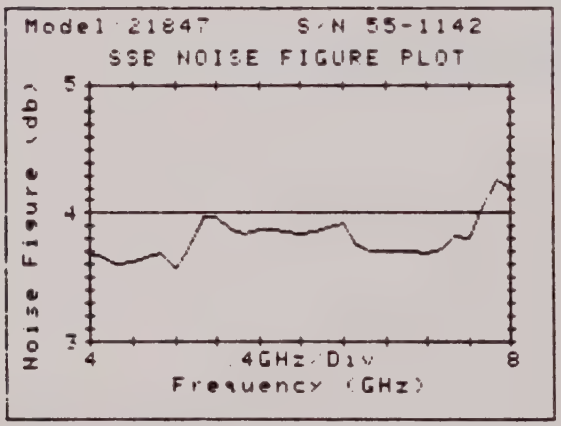
Gain: 44 dB

ENR data, supplied with HP 346B.

2nd Stage NF: Not required, sufficient 1st stage gain.

Measurement Steps: 31 (133 MHZ)

HP-85 Controller



Single Sideband
Noise Figure Measurement

MODEL #	21847
S/N	55-1142
Tested by	WP
Date	05/18/1983
Time	02:26:29

Freq. MHz.	P (dbm) (NS off)	P (dbm) (NS on)	NF (dB)
4000	-40.60	-29.02	3.68
4133	-39.53	-27.92	3.65
4266	-39.21	-27.56	3.61
4400	-39.02	-27.39	3.63
4533	-39.34	-27.73	3.65
4666	-40.68	-29.10	3.68
4800	-39.66	-27.98	3.58
4933	-37.92	-26.38	3.73
5066	-39.19	-27.88	3.97
5200	-41.38	-30.07	3.97
5333	-41.25	-29.85	3.88
5466	-39.87	-28.44	3.84
5600	-39.49	-28.09	3.88
5733	-39.82	-28.42	3.88
5866	-40.14	-28.72	3.86
6000	-39.89	-28.45	3.83
6133	-39.62	-28.20	3.86
6266	-39.75	-28.37	3.90
6399	-40.41	-29.06	3.93
6533	-40.36	-28.85	3.76
6666	-39.31	-27.75	3.70
6799	-39.55	-27.99	3.70
6933	-39.02	-27.46	3.70
7066	-39.10	-27.49	3.70
7199	-39.13	-27.51	3.69
7333	-38.46	-26.87	3.72
7466	-39.29	-27.79	3.82
7599	-39.08	-27.57	3.81
7733	-40.35	-29.07	4.06
7866	-40.96	-29.87	4.26
7999	-40.83	-29.69	4.21

INTEGRA
MICROWAVE
A Division of INTEGRA, Inc.
2368 Walsh Ave., Santa Clara, CA 95051
Telephone: (408) 727-9601/TWX: 910-338-0585

References:

1. N. Kuhn, "Noise-Figure Test Setup Provides High Accuracy", Microwaves pp 73-75 (November, 1979)

2. Hewlett Packard Data Sheet, "346B Noise Source" 5952-8209D, (August 1979)

3. H. Swain, "Technique for Increased Accuracy in Noise Figure Measurement", RF & Microwave Measurement Synposium and Exhibition, Hewlett Packard.

4. N. Kuhn, "Getting Started with Automatic Noise Figure Measurements", MSN pp 120-136 (January 1983)

5. S. F. Adam, "Microwave Theory and Applications", Hewlett Packard, Prentice-Hall (1969) pp 490-500.

2.6 APPLICATION SOFTWARE

Program Notes:

Program ID and Revisions

The Program for the automatic Noise Figure measurement with the HP85A is called "NF03A". The present release is Release 1.1 (April 84).

Automatic Corrections incorporated in Program "NF03A".

The automatic Noise Figure measurement program corrects for the following variances:

- ENR-VARIATIONS
- Acutal Tc of Noise Source
- 2nd Stage Correction

ENR-Variations:

The ENR-values as function of frequency is given by the manufacturer of the Noise Source (e.g. HP, Ailtech etc.)

The program assumes that the ENR-values are stored as Data statements in the program.

It assumes that ENR-values are stored at 1 GHz-frequency intervals starting at 1 GHz.

e.g.

```
2820 ! ENR DATA FOR HP346C,
2830 S2$="S/N 2048A00320"
2840 DATA 13.49,13.52,13.35,13.5
8,13.67,13.8,14.04,14.33,14.55,1
4.77,15.04,15.16,15.37,15.42
2850 DATA 15.66,15.46,15.56,15.6
,15.62,15.91,15.9,16.13,16.28,16
.22,16.17,16.16,15.6
```

The first ENR value @ 1 GHz, the second ENR-value is @ 2 GHz...up to 26.5 GHz. Each value has to be separated by a comma (,) from the adjacent value. Be sure that 27 data points are entered.

If not all values are given a linearly interpolated value should be used.

The program will load this value into an Array R1 (I) for use in the program. For any measurement frequency a value is calculated from the two adjacent values (linear interpolation).

The serial # of the noise source should also be entered for identification of the data. If uncorrct ENR-data is used the system cannot measure accurate Noise Figure.

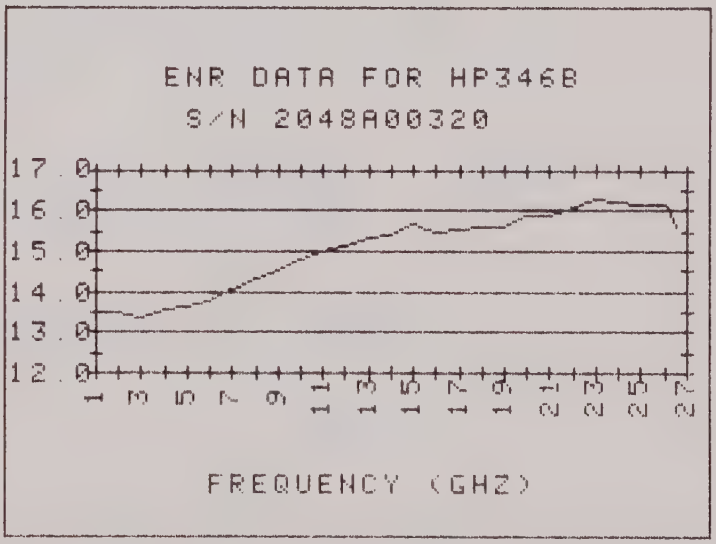
Before any Measurement make sure
the stored data agrees with
the Noise Source used.

The stored data can be listed at the beginning of the program. A graphics representation allows a quick check of the stored data.

e.g.

ENR-DATA IN MEMORY
HP346B-NOISE SOURCE
S/N 2048A00320

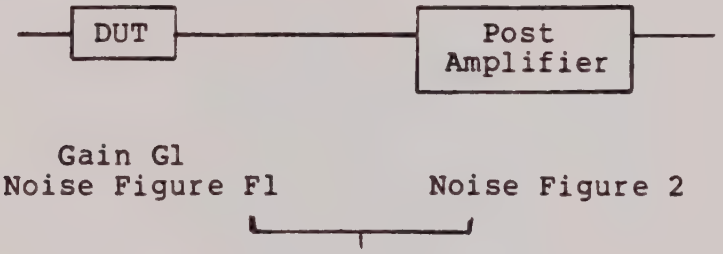
FREQ.(MHZ)	ENR
1000	13.49
2000	13.52
3000	13.35
4000	13.58
5000	13.67
6000	13.80
7000	14.04
8000	14.33
9000	14.55
10000	14.77
11000	15.04
12000	15.16
13000	15.37
14000	15.42
15000	15.66
16000	15.46
17000	15.56
18000	15.60
19000	15.62
20000	15.91
21000	15.90
22000	16.13
23000	16.28
24000	16.22
25000	16.17
26000	16.16
26500	15.60



2nd Stage Correction

The Noise powers that are measured, N2 and N1, include noise added by the DUT and the post amplifier. The relationship between the overall noise figure F12 (expressed as a numerical ratio and not in db) and the individual parameters (as ratio) is given by

$$F12 = F1 + \frac{F2-1}{G1}$$



Note that the post amplifier noise figure F2 is divided by G1. For measurements where G1 is high (e.g. 1000=30db) or more the second term is usually insignificant. For amplifiers or devices where G1 is on the order of 10 or less, the second term becomes very significant.

Since F2 and G1 can easily be measured the data can be inserted into the program for automatic correction. Since it is easier to work in dbs the above formula has been converted and rearranged to:

$$10^{\left(\frac{F1(db)}{10}\right)} = 10^{\left(\frac{F12(db)}{10}\right)} - \left[\frac{10^{\left(\frac{F2(db)}{10}\right)} - 1}{10^{\left(\frac{G1(db)}{10}\right)}}\right]$$

"(Expression of a noise figure as a numeric ratio is written as F, and a noise figure in db is written as F(db).)

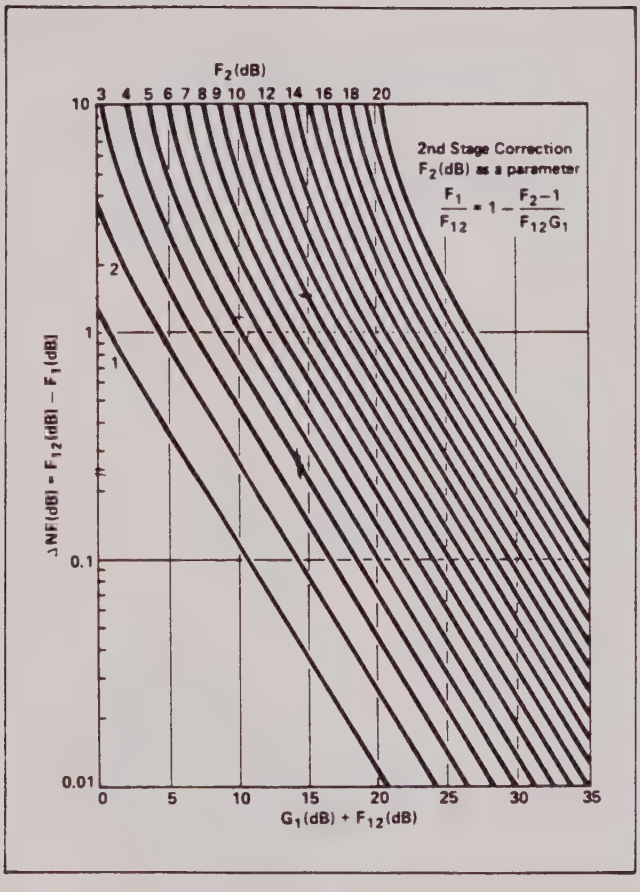
The values which can be entered into the program have to be in db for gain G1 and Noise Figure F2.

e.g.

```
DO YOU WANT TO CORRECT SECOND
STAGE CONTRIBUTION?(Y/N)[N]:?
Y
ENTER NF OF SECOND STAGE IN DB:?

5
ENTER GAIN OF FIRST STAGE IN DB
?
12
```

2nd Stage Correction Cont.



nf 2.6 cont/S0

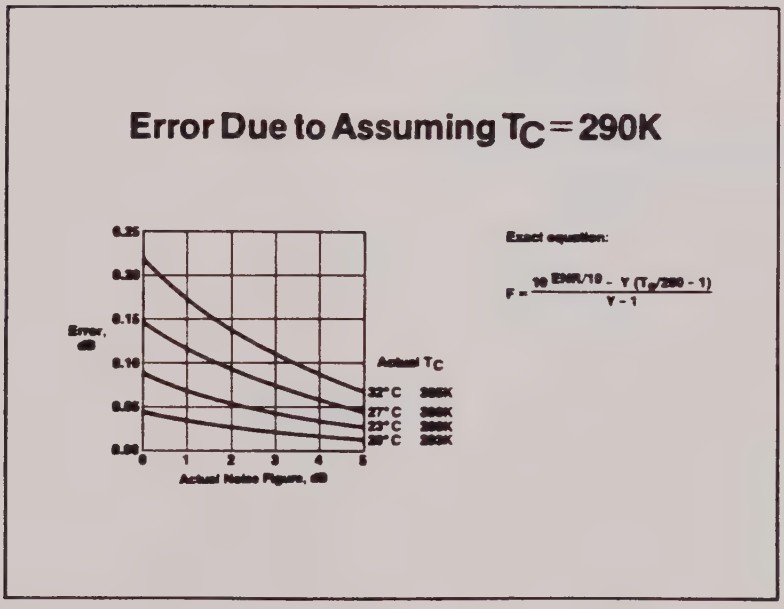
Actual Tc of the Noise Source

Since most Solid State Noise Sources are calibrated at 290° Kelvin (17° Celsius) a correction is required to eliminate the error due to assuming 290°K.

The program allows to enter a new cold temperature in degrees Celsius. The default value is +27° Celsius (300°Kelvin.)

e.g.

```
DO YOU WANT TO CHANGE THE
AMBIENT TEMP (SET TO 27
DEG.C.(Y/N)[N]?
Y
ENTER NEW AMBIENT TEMP.
IN DEG. C:?
25
```



TEST SET-UP FOR NOISE FIGURE MEASUREMENT

Figure 1 shows a typical test set-up for the program "NF02A".

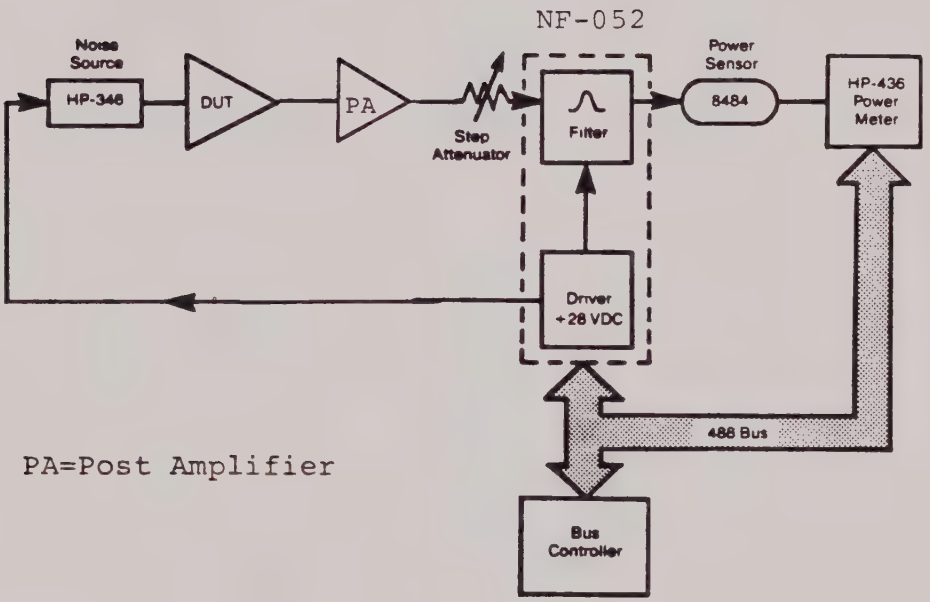


FIGURE 1

List of Equipment:

QTY	ITEM	MODEL #	MANUFACTURER
1	Noise Filter	NF-226	INTEGRA
1	Noise Source	HP346C	HP
1	BNC-Cable (1 meter)		
1	Power Meter with 488	HP436A	HP
1	Power Sensor	HP8484	HP
1*	Bus Controller HP85 with	HP85A	HP
	following options:		
	1 ea HPIB-Interface	82937A	HP
	1 ea 16K MEMORY MODULE	82903A	HP
	1 ea ROM DRAWER	82936A	HP
	1 ea I/O ROM	00085-15003	HP
	1 ea ADV PROG ROM	00085-15005	HP
	1 ea PRINTER PLOTTER ROM	00085-15002	HP
1	IEEE-488 Cable (1 meter)		

* Bus Controller with all necessary option is available as System "IDEA 3001" from Wolf Computer, 301 N. Santa Cruz Ave., Los Gatos, CA 95030, (408) 354-1210, contact Don Wolf.

Running the Program "NF03A"

1.) Set up equipment as outlined.
Turn on all equipment and let it warm up.

2.) Load Test Program "NF03A"
Then press RUN. (The computer will need a second or two to allocate the variables and then will begin the program.

3.) The program will ask for printing of ENR values in memory. This is a good check to make sure the correct noise source is used in the system.

4.) Next is the "SYSTEM SET-UP" which allows to choose the following:

- Print Data ?
- Graph Data ?
- Copy Graph ?
- Second Stage NF-Correction ?
- Ambient Temperature change ?
- Enter Date
- Enter Time

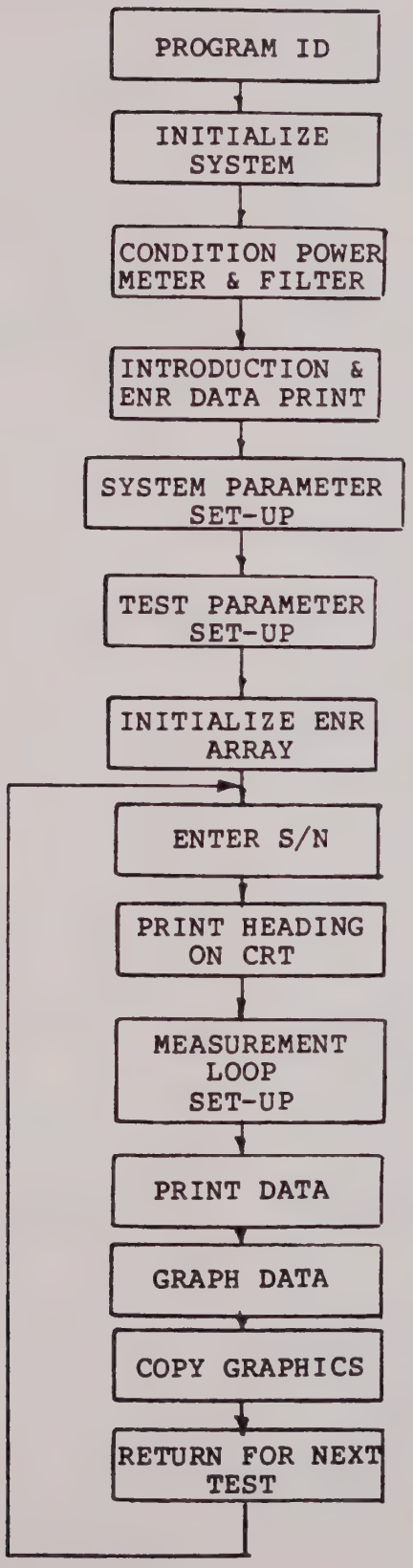
5.) Next is the "TEST PARAMETER SET-UP" which allows to enter:

- Model Number of unit under test.
- Enter Testers Name
- Enter Start Frequency
- Enter Stop Frequency
- Enter # of meas. points.

6.) Now the Test-Loop starts.
First it will ask for the Serial Number of the unit under test, followed by a power meter zeroing procedure (automatic) and executing all the measurements and displays as selected before. After completion the program will ask for the serial number of the next unit to be tested.

If any system or test parameter need to be changed simply pause the program by pushing "PAUSE" followed by "RUN". (After pushing "RUN" the computer needs a second or two to allocate all the variables).

PROGRAM OUTLINE



```
! ************************
!
!       PROGRAM ID
!
! ************************
!
! PROGRAM NAME "NF03A"
! PROGRAM RELEASE 1.1
!
! ************************
!
! FUNCTION: MEASURE NOISE
!           FIGURE WITH NF-226
!
! ************************
!
! WRITTEN BY WS,WMP
! DATE : 09/10/84
!
!
! ******************
! INITIALIZE SYSTEM
! ******************
!
! NF at ADDRESS 705
! POWER METER at ADDR. 713
!
PENUP
DIM D(99,3)
DIM P1$[20],R1(30)
F1=0
F2=0
F4$="100"
F5$="101"
G1=100
N1=0
N2=1.000001
R5$="N"
R6$="N"
R7$="N"
T1=300
W1=200
!
!
! ************************
! CONDITION FILTER + POWER
      METER
! ************************
!
OUTPUT 705 ;"0000100"
OUTPUT 713 ;"9D+T"
ENTER 713 ; P$
OUTPUT 713 ;"9D+T"
ENTER 713 ; P$
!
!
! ************
! INTRODUCTION
! ************
!
GOSUB 4810 @ ! INTRODUCTION
!
CLEAR @ DISP @ DISP @ DISP @
 DISP
DISP "PRINT ENR DATA IN MEMO
RY (Y/N)?:[Y]";
INPUT A7$@ IF UPC$(A7$)="N"
THEN GOTO 700
GOSUB 3920 @ ! PRINT ENR DAT
A
!
!
! ************************
! SYSTEM-PARAMETER SETUP
! ************************
!
CLEAR
DISP "    NOISE FIGURE TEST
(NF03A)"
DISP "          SYSTEM SET-U
P" @ DISP "----------------
--------------"
DISP "PRINT DATA (Y/N)? [Y]"
;
INPUT R7$
DISP "GRAPH DATA (Y/N)? [Y]"
;
INPUT R6$
IF R6$="N" THEN 820
DISP "COPY GRAPH (Y/N)? [Y]"
;
INPUT R5$
DISP "DO YOU WANT TO CORRECT
 SECOND   STAGE CONTRIBUTION
?(Y/N)[N]:";
INPUT R8$
IF R8$="Y" THEN 850 ELSE 890
DISP "ENTER NF OF SECOND STA
GE IN DB:";
INPUT N2
DISP "ENTER GAIN OF FIRST ST
AGE IN DB:";
INPUT G1
DISP "DO YOU WANT TO CHANGE
THE       AMBIENT TEMP.(SET
TO";IP(T1-273);"DEG.C.(Y/N)[
N]";
INPUT R9$
IF R9$="Y" THEN 920 ELSE 980
DISP "ENTER NEW AMBIENT TEMP
.          IN DEG. C:";
INPUT T2
IF 13>T2 OR T2>33 THEN 950 E
LSE 970
DISP "CHECK NEW TEMP. ENTRY
(DEG. C)!!"
GOTO 920
T1=273+T2
!
DISP "ENTER DATE (MM/DD/YYYY
):";@ INPUT D1$
```

```
1000 DISP "ENTER TIME (HH:MM:SS)
     :";@ INPUT D2$
1010 ! D3$=D2$[1,2]
1020 ! D4$=D2$[4,5]
1030 ! D5$=D2$[7,8]
1040 ! SETTIME VAL(D3$)*60*60+VA
     L(D4$)*60+VAL(D5$),0
1050 !
1060 !
1070 ! **********************
1080 ! TEST-PARAMETER SETUP
1090 ! **********************
1100 !
1110 CLEAR
1120 DISP "       TEST PARAMETER"
1130 DISP "            SET-UP"
1140 DISP "-----------------------
     ----------"
1150 DISP "ENTER MODEL NUMBER:";
     @ INPUT M1$
1160 !
1170 DISP "ENTER TESTER NAME:";@
      INPUT N1$
1180 !
1190 DISP "ENTER START FREQ. IN
     MHZ:";@ INPUT F1
1200 IF 26500<F1 OR F1<2000 THEN
      GOTO 3040
1210 DISP "ENTER STOP FREQ. IN M
     HZ:";@ INPUT F2
1220 IF 26500<F2 OR F2<2000 THEN
      GOTO 3120
1230 DISP "ENTER # OF MEAS. POIN
     TS:";@ INPUT N1
1240 !
1250 !
1260 ! **********************
1270 ! INITIALIZE ENR-ARRAY
1280 ! **********************
1290 !
1300 GOSUB 2740 ! LOAD ENR DATA
1310 !
1320 !
1330 ! *********
1340 ! ENTER S/N
1350 ! *********
1360 !
1370 CLEAR
1380 DISP "ENTER S/N:";@ INPUT S
     1$
1390 !
1400 PRINTER IS 1 @ CLEAR
1410 !
1420 !
1430 ! *************
1440 ! PRINT HEADING
1450 ! *************
1460 !
1470 PRINT
1480 PRINT "       SINGLE SIDEBA
     ND             NOISE FIGURE
      MEASUREMENT"
1490 PRINT "-------------------
     -----------"
1500 PRINT "MODEL #    : ";M1$
1510 PRINT "S/N        : ";S1$
1520 PRINT "Tested by  : ";N1$
1530 PRINT "Date       : ";D1$
1540 PRINT "Time       : ";TIME$
1550 ! PRINT
1560 PRINT "-------------------
     -----------"
1570 PRINT "Freq.    P (dB)    P (
     dB)     NF   "
1580 PRINT "MHz.    (NS off) (NS
     on)    (dB) "
1590 PRINT "-------------------
     -----------"
1600 ! PRINT
1610 !
1620 !
1630 ! **********************
1640 ! MEASUREMENT-LOOP SETUP
1650 ! **********************
1660 !
1670 GOSUB 4650 @ ! Pwr-ZERO
1680 FOR N=0 TO N1-1
1690 F3=INT(F1+N*((F2-F1)/(N1-1)
     ))
1700 GOSUB 2890 ! interp ENR
1710 D(N,0)=F3
1720 I4=INT(65535*F3/26500)
1730 GOSUB 5400 @ ! convert to h
     ex
1740 F6$=I7$&F4$ @ ! freq.no noi
     se
1750 GOSUB 5540 @ ! convert to t
     ransmission code and send
1760 WAIT W1
1770 !
1780 !
1790 ! **********************
1800 ! MEAS. POWER WITH NOISE
1810 ! SOURCE OFF
1820 ! **********************
1830 !
1840 GOSUB 2550 @ ! measure pwr
1850 D(N,1)=D1
1860 !
1870 !
1880 ! ********************
1890 ! TURN ON NOISE SOURCE
1900 ! ********************
1910 !
1920 F7$=I7$&F5$ @ ! freq.+noise
1930 GOSUB 5660 @ ! convert to t
     ransmission code and send
1940 !
1950 !
1960 ! **********************
1970 ! MEAS. POWER WITH NOISE
            SOURCE ON
```

```
1980 ! **********************
1990 !
2000 GOSUB 2550 @ ! measure pwr
2010 D(N,2)=D1
2020 !
2030 !
2040 ! **********************
2050 ! TURN OFF NOISE SOURCE
2060 ! **********************
2070 !
2080 GOSUB 5540
2090 !
2100 !
2110 ! **********************
2120 ! CALCULATE NOISE FIGURE
2130 ! **********************
2140 !
2150 A=10*LGT(10^(E1/10)-10^((D(
     N,2)-D(N,1))/10)*(T1/290-1)
     )
2160 B=10*LGT(10^((D(N,2)-D(N,1)
     )/10)-1)
2170 E3=(10^(N2/10)-1)/10^(G1/10
     ) @ ! SECOND STAGE TERM
2180 E4=A-B @ ! MEASURED F(12)(D
     B)
2190 E5=10^(E4/10) @ ! MEASURED
     F(12)(RATIO)
2200 E6=E5-E3 @ ! NOISE FIGURE F
     1
2210 D(N,3)=10*LGT(E6)
2220 !
2230 !
2240 ! **********
2250 ! PRINT DATA
2260 ! **********
2270 !
2280 IMAGE DDDDD,3X,DDD.DD,3X,DD
     D.DD,2X,DD.DD
2290 PRINT USING 2280 ; D(N,0),D
     (N,1),D(N,2),D(N,3)
2300 !
2310 !
2320 ! *********
2330 ! LOOP BACK
2340 ! *********
2350 !
2360 NEXT N
2370 PRINT "--------------------
     -----------"
2380 PRINT
2390 IF UPC$(R7$)="N" THEN 2410
2400 GOSUB 4980 @ ! PRINT HEADIN
     G
2410 IF UPC$(R6$)="N" THEN 2430
2420 GOSUB 3190 @ ! AUTOSCALING
2430 IF UPC$(R5$)="N" THEN 2510
2440 GOSUB 5350 @ ! COPY GRAPHIC
     S
2450 !
2460 !
2470 ! **********************
2480 ! RETURN FOR NEXT TEST
2490 ! **********************
2500 !
2510 CLEAR @ GOTO 1330
2520 !
2530 !
2540 ! ************************
2550 ! POWER MEAS. SUBROUTINE
2560 ! ************************
2570 !
2580 OUTPUT 713 ;"9D+T"
2590 ENTER 713 ; P$
2600 IF N>0 THEN 2630
2610 OUTPUT 713 ;"9D+T"
2620 ENTER 713 ; P$
2630 P1$=P$[1,1]
2640 IF P1$="P" THEN 2700
2650 DISP "MEASURED VALUE NOT VA
     LID"
2660 DISP "STATUS CHARACTER:";P1
     $
2670 DISP "                  Press [
     CONT]" @ BEEP
2680 PAUSE
2690 GOTO 2580
2700 D1=VAL(P$[4,12])
2710 RETURN
2720 !
2730 !
2740 ! ************************
2750 ! ENR DATA TO BE LOADED
2760 ! ************************
2770 !
2780 RESTORE
2790 FOR I=1 TO 27
2800 READ R1(I)
2810 NEXT I
2820 ! ENR DATA FOR HP346B,
2830 S2$="S/N 2048A00320"
2840 DATA 13.49,13.52,13.35,13.5
     8,13.67,13.8,14.04,14.33,14
     .55,14.77,15.04,15.16,15.37
     ,15.42
2850 DATA 15.66,15.46,15.56,15.6
     ,15.62,15.91,15.9,16.13,16.
     28,16.22,16.17,16.16,15.6
2860 RETURN
2870 !
2880 !
2890 ! ************
2900 ! INTERP. ENR
2910 ! ************
2920 !
2930 IF F3>26500 THEN E1=R1(27)
     ELSE GOTO 2950
2940 GOTO 3010
2950 R2=R1(IP(F3/1000))
2960 R3=R1(1+IP(F3/1000))
```

```
2970 IF R2>R3 THEN GOTO 3000
2980 E1=R2+(R3-R2)*(F3/1000-IP(F
     3/1000))
2990 GOTO 3010
3000 E1=R2-(R2-R3)*(F3/1000-IP(F
     3/1000))
3010 RETURN
3020 !
3030 !
3040 ! **********************
3050 ! OUT OF RANGE MESSAGE
3060 ! **********************
3070 !
3080 DISP "CHECK TO SEE THAT F1
     IS IN RANGE (2000 <= F1 <=
     26500)"
3090 BEEP
3100 DISP
3110 GOTO 1190
3120 BEEP
3130 DISP "CHECK TO SEE THAT F2
     IS IN RANGE (2000 <= F2 <=
     26500)"
3140 DISP
3150 GOTO 1210
3160 !
3170 !
3180 ! ******************
3190 ! AUTOSCALING GRAPH
3200 ! ******************
3210 !
3220 V1=16 @ V2=0
3230 FOR N=0 TO N1-1
3240 IF V1>D(N,3) THEN V1=D(N,3)
3250 IF V2<D(N,3) THEN V2=D(N,3)
3260 NEXT N
3270 R=IP(V2+1)-IP(V1)
3280 IF R>16 THEN R=16
3290 IF R>10 THEN R=10
3300 IF R<1 THEN R=1
3310 IF R<=16 THEN R1=2
3320 IF R<=10 THEN R1=1
3330 IF R<=8 THEN R1=.5
3340 IF R<=6 THEN R1=.25
3350 IF R<=4 THEN R1=.2
3360 IF R<=2 THEN R1=.1
3370 R2=IP(V1)
3380 R3=IP(V2+1)
3390 S0=120/R @ S1=200/(F2-F1)
3400 GCLEAR
3410 LDIR 0
3420 SCALE -40,216,-36,156
3430 FRAME
3440 XAXIS 0,(F2-F1)/10*S1,0,200
3450 XAXIS 120,(F2-F1)/10*S1,0,2
     00
3460 YAXIS 0,R1*S0,0,120
3470 YAXIS 200,R1*S0,0,120
3480 LORG 8
3490 FOR M=0 TO R
3500 MOVE 0,M*S0
3510 LABEL R2+M
3520 NEXT M
3530 FOR M=1 TO R-1
3540 XAXIS S0*M,200,0,200
3550 NEXT M
3560 LORG 4
3570 MOVE 100,125
3580 LABEL "SSB NOISE FIGURE PLO
     T"
3590 LORG 6
3600 MOVE 0,-5
3610 LABEL F1/1000
3620 MOVE 200,-5
3630 LABEL F2/1000
3640 MOVE 100,-5
3650 L1$=VAL$(IP((F2-F1)/10)/100
     0)
3660 L2$="GHz/Div"
3670 LABEL L1$&L2$
3680 MOVE -25,60
3690 LDIR 90 @ LORG 4
3700 LABEL "Noise Figure (db)"
3710 LDIR 0 @ LORG 2
3720 MOVE -30,145
3730 LABEL "Model:";M1$
3740 MOVE 100,145
3750 LABEL "S/N:";S1$
3760 LORG 6
3770 MOVE 100,-20
3780 LABEL "Frequency (GHz)"
3790 FOR N=0 TO N1-1
3800 PLOT (D(N,0)-F1)*S1,120/R*(
     D(N,3)-R2)
3810 NEXT N
3820 IF R5$="Y" THEN 3830 ELSE 3
     850
3830 COPY
3840 GOTO 3860
3850 WAIT 1000 @ GOTO 3860
3860 ALPHA
3870 ! PRINT
3880 ! PRINT "          PROGRAM N
     F03A"
3890 RETURN
3900 !
3910 !
3920 ! ***************
3930 ! ENR DATA PRINT
3940 ! ***************
3950 !
3960 PRINTER IS 2
3970 GOSUB 2750 @ ! LOAD ENR-DAT
     A
3980 PRINT
3990 PRINT "ENR-DATA IN MEMORY"
4000 PRINT "HP346B-NOISE SOURCE"
4010 PRINT S2$
4020 PRINT "--------------------
     -------"
```

```
4030 PRINT "FREQ.(MHZ)
     ENR"
4040 PRINT "--------------------
     -------"
4050 FOR I=1 TO 27
4060 IF I=27 THEN PRINT USING 41
     00 ; 26500,R1(I)
4070 IF I=27 THEN 4110
4080 PRINT USING 4100 ; 1000*I,R
     1(I)
4090 NEXT I
4100 IMAGE X, 5D,16X,2D.2D
4110 PRINT
4120 !
4130 !
4140 ! ***************
4150 ! ENR DATA GRAPH
4160 ! ***************
4170 !
4180 GCLEAR
4190 SCALE -3,28,8,21
4200 XAXIS 12,1,1,27
4210 XAXIS 17,1,1,27
4220 YAXIS 1,.5,12,17
4230 YAXIS 27,.5,12,17
4240 XAXIS 13,27,1,27
4250 XAXIS 14,27,1,27
4260 XAXIS 15,27,1,27
4270 XAXIS 16,27,1,27
4280 LDIR 90
4290 FOR N=1 TO 9 STEP 2
4300 MOVE N+.5,10.7
4310 LABEL N
4320 NEXT N
4330 FOR N=11 TO 27 STEP 2
4340 MOVE N+.5,10.42
4350 LABEL N
4360 NEXT N
4370 LDIR 0
4380 K9=-2.8
4390 MOVE K9,11.75
4400 LABEL "12.0"
4410 MOVE K9,12.75
4420 LABEL "13.0"
4430 MOVE K9,13.75
4440 LABEL "14.0"
4450 MOVE K9,14.75
4460 LABEL "15.0"
4470 MOVE K9,15.75
4480 LABEL "16.0"
4490 MOVE K9,16.75
4500 LABEL "17.0"
4510 MOVE 6,9
4520 LABEL "FREQUENCY (GHZ)"
4530 MOVE 4,19
4540 LABEL "ENR DATA FOR HP346B"
4550 MOVE 5,18
4560 LABEL S2$
4570 FOR I=1 TO 27
4580 IF I=27 THEN PLOT 26.5,R1(I
     )
4590 IF I=27 THEN 4610
4600 PLOT I,R1(I)
4610 NEXT I
4620 FRAME
4630 COPY
4640 PRINTER IS 1
4650 RETURN
4660 !
4670 !
4680 ! ****************
4690 ! PWR ZERO ROUTINE
4700 ! ****************
4710 !
4720 OUTPUT 705 ;"0000100"
4730 OUTPUT 713 ;"Z1T"
4740 ENTER 713 ; P$
4750 U=VAL(P$[5,8])
4760 IF ABS(U)>2 THEN 4720
4770 OUTPUT 713 ;"9D+T"
4780 ENTER 713 ; P$
4790 U=NUM(P$[1,1])
4800 IF U>=84 THEN 4770
4810 RETURN
4820 !
4830 !
4840 ! *************
4850 ! INTRODUCTION
4860 ! *************
4870 !
4880 CLEAR
4890 DISP @ DISP @ DISP @ DISP
4900 DISP "          I N T E G R
     A "
4910 DISP "       M I C R O W A
     V E"
4920 DISP
4930 DISP
4940 DISP "    NOISE FIGURE TEST
      SETUP"
4950 DISP "             with"
4960 DISP "      NOISE FILTER NF
      226"
4970 WAIT 1000
4980 RETURN
4990 !
5000 !
5010 ! *************
5020 ! PRINT HEADING
5030 ! *************
5040 !
5050 CRT OFF
5060 PRINTER IS 2
5070 PRINT @ PRINT
5080 PRINT "       SINGLE SIDEBA
     ND              NOISE FIGURE
      MEASUREMENT"
5090 PRINT "--------------------
     -----------"
5100 PRINT "MODEL #    : ";M1$
5110 PRINT "S/N        : ";S1$
```

```
5120 PRINT "Tested by : ";N1$
5130 PRINT "Date       : ";D1$
5140 PRINT "Time       : ";TIME$
5150 PRINT
5160 PRINT "--------------------
     -----------"
5170 PRINT "Freq.    P (dB)    P (
     dB)     NF   "
5180 PRINT "MHz.    (NS off) (NS
     on)    (dB) "
5190 PRINT "--------------------
     -----------"
5200 PRINT
5210 !
5220 FOR N=0 TO N1-1
5230 PRINT USING 2280 ; D(N,0),D
     (N,1),D(N,2),D(N,3)
5240 NEXT N
5250 PRINT "--------------------
     ----------"
5260 ! PRINT
5270 PRINT "          PROGRAM NF0
     3A"
5280 PRINT
5290 PRINTER IS 1
5300 CRT ON
5310 RETURN
5320 !
5330 !
5340 ! **************
5350 ! COPY GRAPHICS
5360 ! **************
5370 !
5380 GRAPH
5390 COPY
5400 PRINT
5410 PRINT
5420 RETURN
5430 !
5440 ! ************************
5450 ! TRANSLATE DATA INTO
5460 ! HEX-CODE
5470 ! ************************
5480 !
5490 I5=INT(I4/256)
5500 I6=I4-I5*256
5510 I5$=DTH$(I5)
5520 I5$=I5$[3,4]
5530 I6$=DTH$(I6)
5540 I6$=I6$[3,4]
5550 I7$=I5$&I6$
5560 RETURN
5570 !
5580 ! ************************
5590 ! TRANSLATE DATA INTO
5600 ! TRANSMISSION CODE AND
5610 ! SEND FOR FREQ.+NO NOISE
5620 ! ************************
5630 !
5640 P1$="A:B;C<D=E>F?"
5650 CONVERT OUT 7 PAIRS ; P1$
5660 OUTPUT 705 ;F6$
5670 CONVERT OUT 7
5680 RETURN
5690 !
5700 ! ************************
5710 ! TRANSLATE DATA INTO
5720 ! TRANSMISSION CODE AND
5730 ! SEND FOR FREQ.+ NOISE
5740 ! ************************
5750 !
5760 P1$="A:B;C<D=E>F?"
5770 CONVERT OUT 7 PAIRS ; P1$
5780 OUTPUT 705 ;F7$
5790 CONVERT OUT 7
5800 RETURN
```

3.0 THEORY OF OPERATION

3.1 System Operation

Figure 5 is a block diagram of the INTEGRA Noise Figure Model NF-226. In the analog drive mode, an external drive signal is applied to the EXT DRIVE input. This is buffered and available at the buffered output to drive other instruments. The EXT. DRIVE SELECTOR selects the input range 1 V/GHz or 0.5 V/GHz. The drive section converts this signal to drive the YIG-filter.

The IEEE-488 Bus Control allows complete control over the NF-226. The unit can be controlled with 65536 points resolution over the frequency range. This gives a frequency resolution of .404 MHz/step. The bus can also control relay A and B. Relay A controls the positive drive. Relay B controls the negative frequency drive (used for negative offset, when the unit also uses the EXT. DRIVE INPUT).

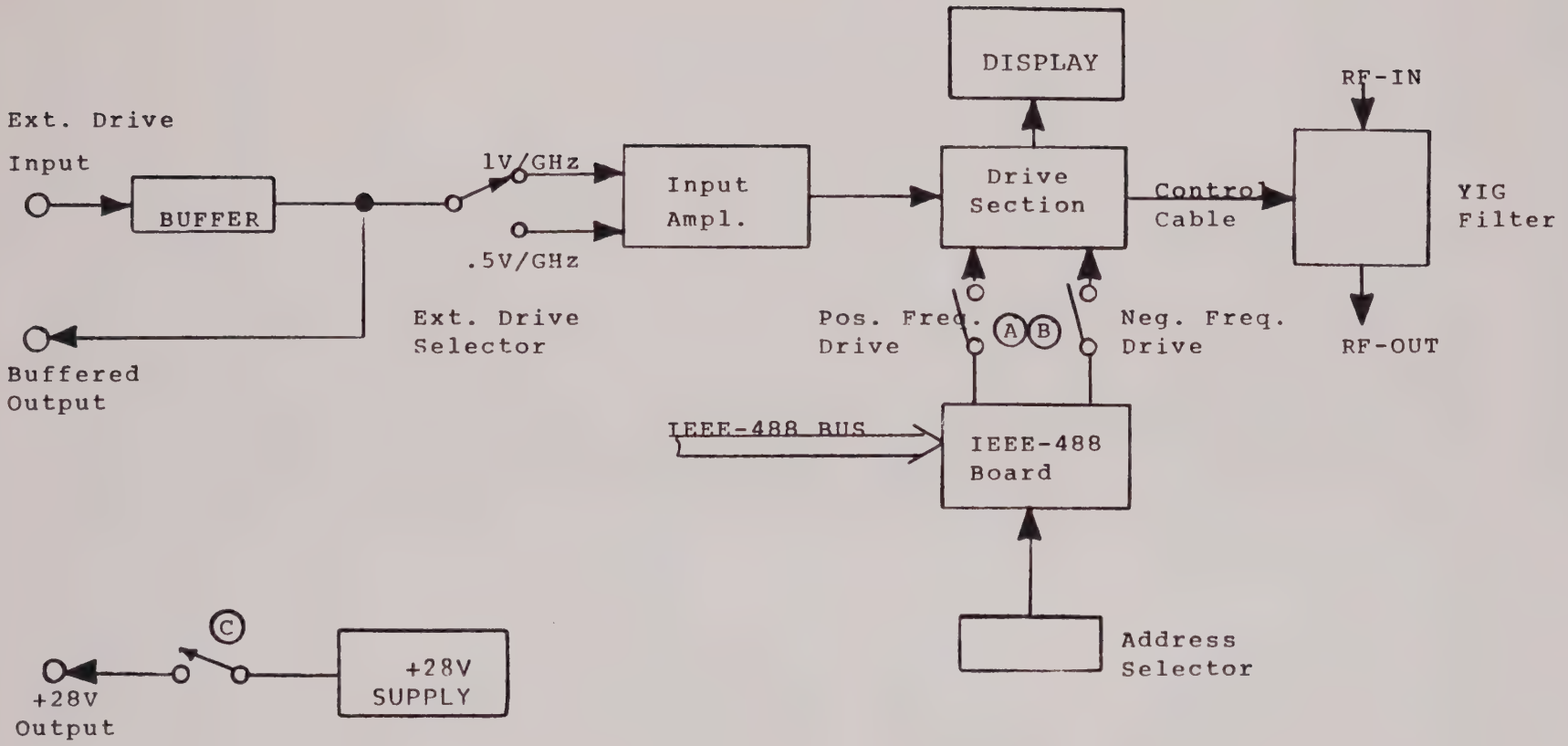


FIGURE 5 NF-226 BLOCK DIAGRAM

4.0 NF-226 CALIBRATION PROCEDURE

The Internal Voltage Calibration procedure section 4.1 and the IEEE-488 Calibration section 4.3 are only used after replacement of potentiometers, operational amplifiers or other parts on the main board or the IEEE-488 Interface Board. The routine Frequency Calibration is covered in Section 4.2 FREQUENCY CALIBRATION. Routine Frequency Calibrations should be performed every 6 months.

4.1 Internal Voltage Calibration

Connect equipment as shown in FIGURE 6. Install 16 pin test adapter in sockets CH1,"CH2 and CH3 located on the Control Unit mother board. Refer to FIGURE 7 for location of sockets and adjustment potentiometers.

4.1.1 Apply power to equipment and allow a warm-up period of 30 minutes before proceeding.

4.1.2 Power Supply Readings: (measured with reference to CH1-2 or CH2-1)

CH1-6: +13 VDC ±10%

CH1-7: -13 VDC ±10%

CH1-1: +11 VDC ±10%

CH1-14: +15 VDC ±5%

CH1-11: -15 VDC ±5%

CH1-5: +5 VDC ±5%

4.1.3 Reference Voltage Adjustments

Adjust R44 for +10.000 V at CH2-13

Adjust R45 for -10.000 V at CH2-12

NOTE: CH1-2 & CH2-1 are chassis ground

4.1.4 External Drive Level Adjustments

Test No	Test Title	Inputs/Set-Up	Measure DVM On	With OSC On	Adj	Measure
1	zero input offset	apply 0.000 VDC on EXT DRIVE INPUT.	CH3-12		R55	0.000 V
2		select .5 V/GHZ input apply +13.250 VDC on EXT DRIVE INPUT.	CH3-12		R4	+10.000 V
3		select 1 V/GHZ input apply +19.990 VDC on EXT DRIVE INPUT.	CH3-12		R3	+7.547V

4.2 Frequency Calibration

4.2.1 Connect instrument as shown in Fig. 6.
Note: allow unit to warm-up for 30 min. with 5.000 V input.

4.2.2 Select .5 V/GHZ

4.2.3 Set VOLTAGE CALIBRATOR to 1.000 V.

4.2.4 Measure @ CH3-12 adj. R4 +0.7547V.

4.2.5 Set sweeper freq to 2.000 GHz with Delta-F of 200 MHz.

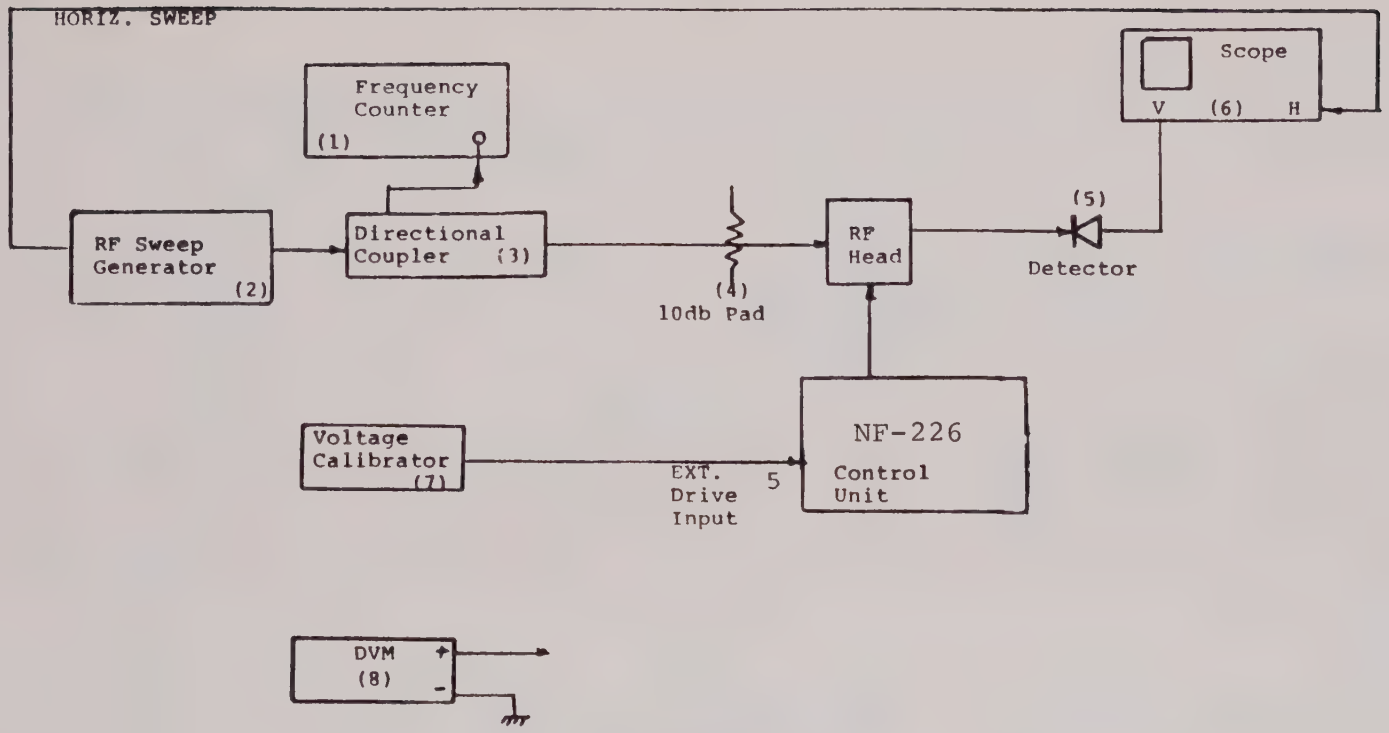
4.2.6 Adj. R48 until passband is centered on scope.

4.2.7 Set sweeper freq. to 18.000 GHz with 200 MHz Delta-F.

4.2.8 Set VOLTAGE CALIBRATOR to 9.000 V.
(measure @ CH3-12 about 6.792 V)

4.2.9 Adj. R49 until passband is centered on scope.

4.2.10 Repeat steps 4.2.3 thru 4.2.10 until both points are calibrated.

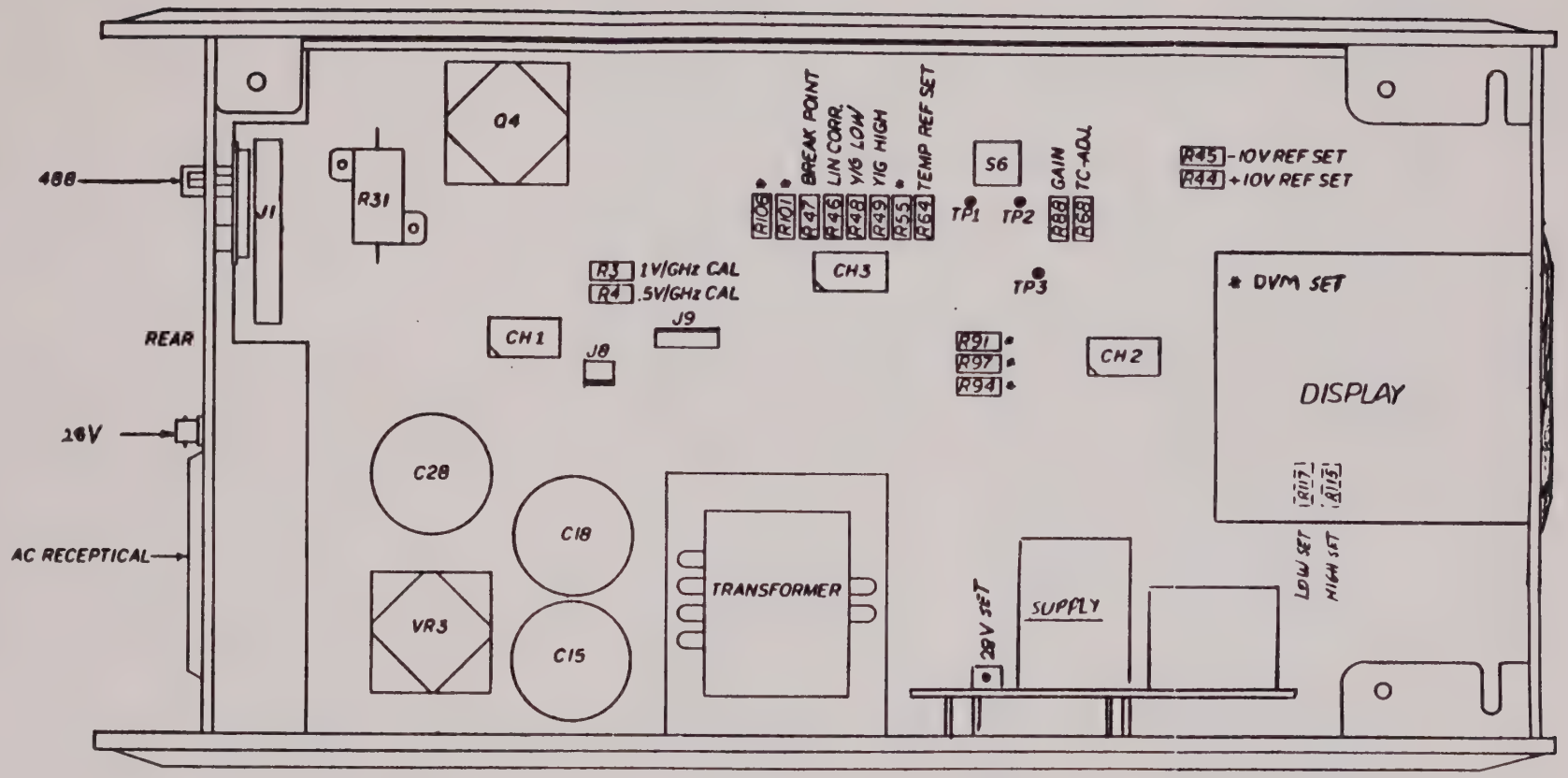


TEST EQUIPMENT LIST

	Item	Model No.	Mfg
1.	Frequency Counter	5343A	Hewlett-Packard
2.	Microwave Sweep Generator	MSG-2110	Integra
3.	Directional Coupler	2616	Krytar
4.	Attenuator	9-10	Weinschel Engineering
5.	Detector	3333C	Hewlett-Packard
6.	Oscilloscope	180A + 1801A	Hewlett-Packard
7.	Digital Voltage Calibrator	DVC-8500	Datel-Intersil
8.	Digital Voltmeter	3465B	Hewlett-Packard

FIGURE 6 CALIBRATION TEST SET-UP

Disk K7



*NOTE: DO NOT ADJUST

FIGURE 7 ADJUSTMENT LOCATION

4.3 IEEE-488 Calibration (Standard)

PROCEDURE: To be performed after all other voltage calibration. (Section 4.1) See FIGURE 8 for Calibration Set Up.

NOTE: The adjustments are on the 488 Board and the Mother Board, measurement points are on Mother Board.

4.3.1 Set-up per FIGURE 8.

4.3.2 Command with controller "0000010" and adj: R4 (on 488 Brd) for 0.000 V on CH3-12.

4.3.3 Command "????010" and adj: R2 (on 488 Brd) for - 10.000 V.

4.3.4 Repeat 2 and 3 until both correct.

4.3.5 Command "0000100" and adj: R 115 for 0.000 V.

4.3.6 Command "????100" and adj: R117 for +10.000 V.

4.3.7 Repeat 4.3.5 and 4.3.6 until both correct.

4.3.8 End of calibration.

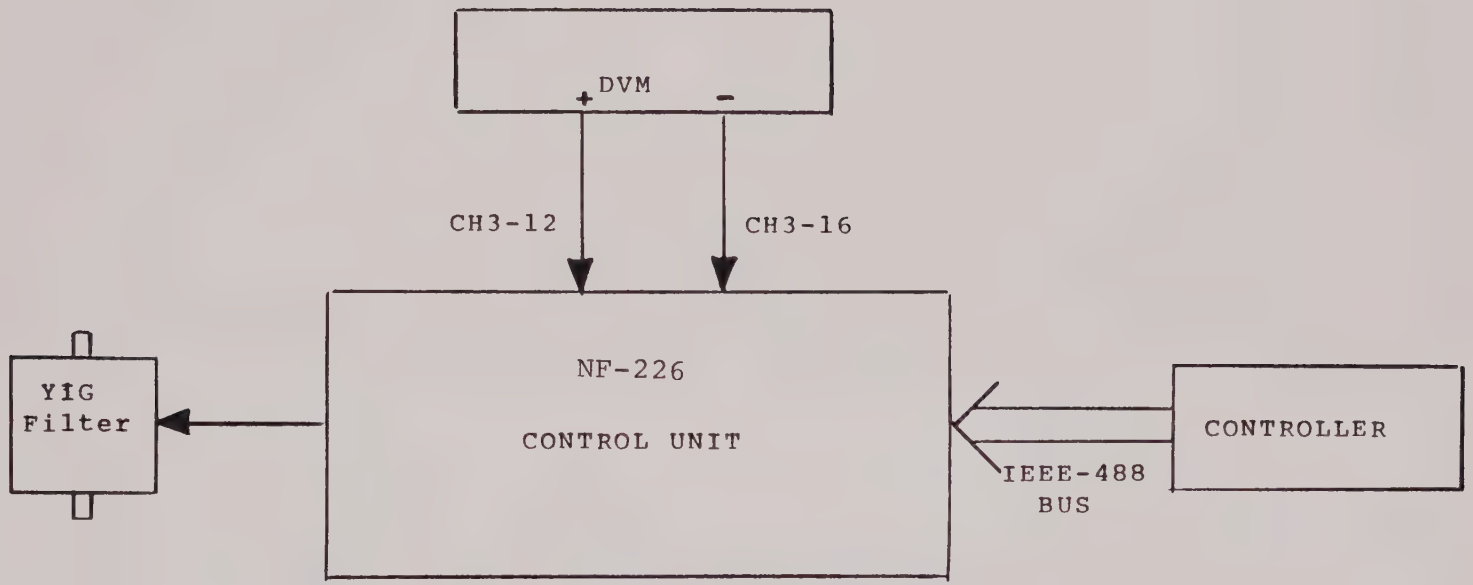


FIGURE 8 IEEE-488 CALIBRATION SET-UP

5.0 CIRCUIT DESCRIPTION

5.1 GENERAL

Figure 9 is a block diagram of the NF-226. The EXT. DRIVE INPUT is buffered and made available on the BUFFERED OUTPUT to drive other instruments. The EXT. DRIVE INPUT selector switch selects the 1 V/GHz or 0.5 V/GHz sensitivity for the EXT. drive input. The DRIVE SECTION combines the analog drive signal from the input amplifier with the drive signals from the IEEE-488 Board. The display indicates the tuned frequency of the Noise Filter. The Drive section also contains a linearizer circuit and the YIG Driver. The RF filter is connected to the Driver Unit through a 5 foot cable (10 ft, optional).

The IEEE-488 INTERFACE can control the Noise Filter without the analog input. The Positive Frequency Drive (Relay A) is selected for this application.

If an analog drive is used it is possible to offset the Noise filter to a higher or lower frequency by adding an offset through the IEEE-488 interface. For positive offsets use Relay A and for negative offsets use relay B.

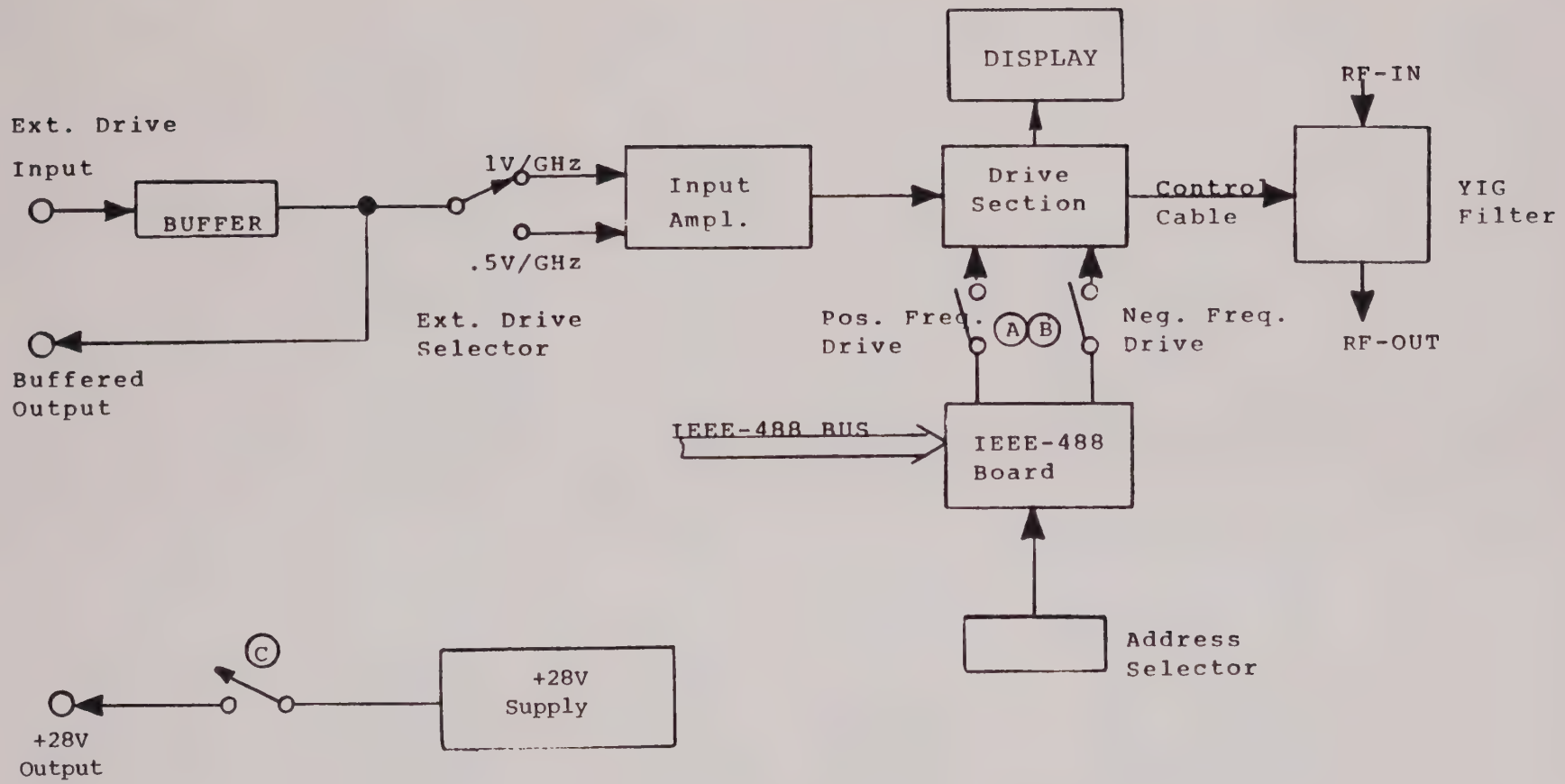


FIGURE 9 NF-226 BLOCK DIAGRAM

5.2 Circuit Description, Control Unit

(See NF-218 Interconnect and Schematic Mother Board NF-218)

Power Supply

Transformer T1 has 3 secondary windings to feed 3 independent integrated regulators (VR1-3). Diodes CR5-CR12 and CR25-CR28 form three bridge rectifiers. Diodes CR13-16 and CR23-24 are reverse polarity protections for the integrated regulators. CR18 is a LED-power indicator for the front panel.

Ref. Voltage Supply

IC5 is a +10.000 V-Positive Ref. Supply (adjustable by R44). IC6 generates a -10.000 V reference voltage (adjustable by R45).

Buffer Amplifier

IC7 is a high voltage buffer amplifier for the EXT. Drive signal. The gain is +1.

EXT. Drive Input Amplifier

IC1 is an inverting amplifier and accepts either 0 to 20 V (on CH1-10) or 0 to 10 V (on CH1-9). R3 and R4 calibrate the input ranges. CR22 limits the output range and polarity of IC1.

INTERNAL SUMMING AMPLIFIER

IC2 is the internal summing amplifier. IC2, R13, and R16 form an inverting amplifier with a gain of -1. R55-R60 provide an offset voltage compensation for IC2.

Relay K2 applies a 0 to +10 V signal from the IEEE-488 Board to R76 for negative offset.

Relay K3 applies a 0 to -10 V signal from the IEEE-488 Board to R78 for positive offset (When used with EXT. INPUT DRIVE) or as the main drive signal when the EXT INPUT DRIVE is disconnected (input of 0V).

Remote Indicator Circuit

CR24-CR31, R73, 74, 83, 84, and R87 form a REMOTE-indicator. Whenever any of the 2 relays is activated, the REMOTE indicator CR31 lights up. CR31 also lights up when the command for the +28V supply is given.

Yig Driver

IC3 is the YIG-Driver summing amplifier. R17, R18, and R48, allow YIG-LOW FREQUENCY CALIBRATION. R19, R20, and R49 are used for YIG HIGH FREQUENCY CALIBRATION. R21-23 and C8 is an optional YIG delay compensation circuit.

IC4 and Q1-Q4 form a current booster for the YIG driver. R31 is the current sense resistor and feeds back a voltage proportional to the YIG current.

YIG Linearizer

R38, 39, 46, 47, and CR3 form an adjustable linearizer circuit to compensate for YIG nonlinearity (Optional).

+28V - Power Supply

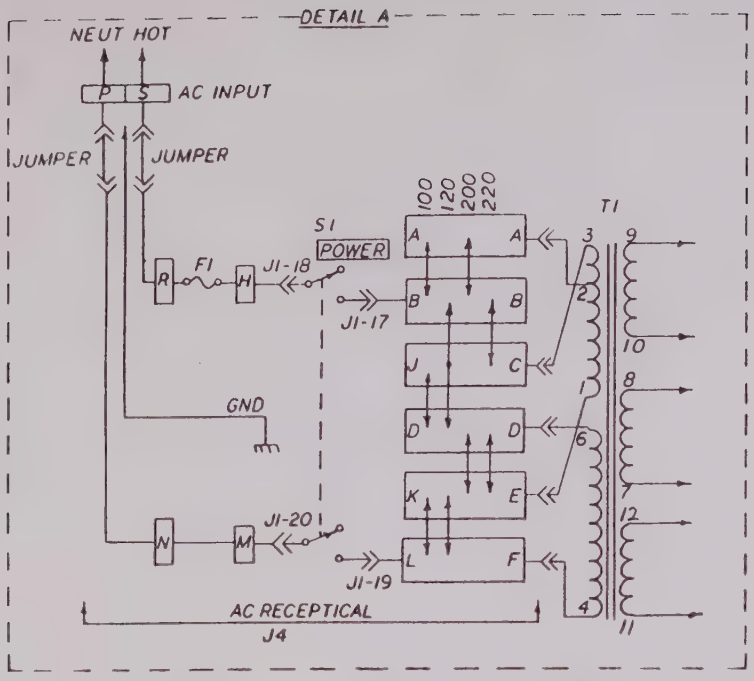
An independent Power Supply is used to generate the +28V to drive the noise source. Transformer T1 drives the full wave rectifier circuit CR1-CR4. C1 is the filter capacitor and VK1 is and adjustable voltage regulator. R2 adj. the output voltage. Transistor Q1, Q2, and resistor R4-R8 are used to turn the +28V supply on and off under computer control. (control signal received through the IEEE-488 Interface Board).

5.3 Circuit Description, IEEE-488 Interface Board

The 488 Board is controlled by way of the 488 Interface Bus. The data is received and transmitted by IC19 and IC20. LED (CR7) indicates the power-up procedure is complete. IC8 is the central processor which sends instructions to IC9 and IC10. IC9 controls IC1, which is a 16 bit digital to analog converter. IC1 provides the 0 to +10.000 V analog signal. IC10 provides the control skgnal for K2 and K3 on the Mother Board.

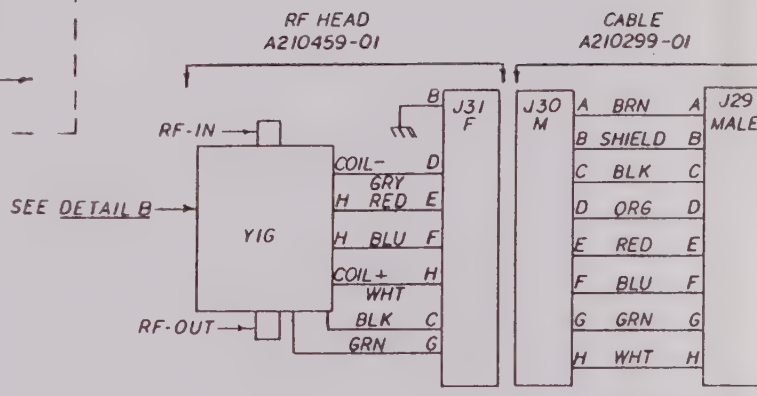
6.0 Schematics and Assembly Drawings

NOTE: THE
THE 488
AS SHOW



AC POWER CORD IN

SEE DETAIL A

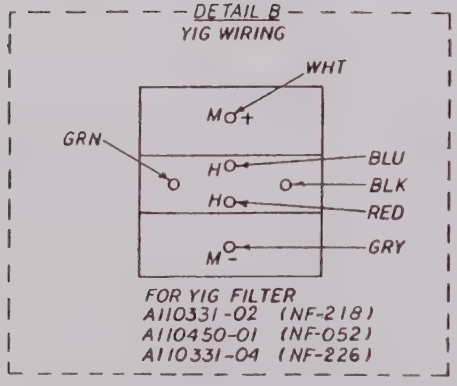


INPUT SELECT 1V/G
.5 V/G

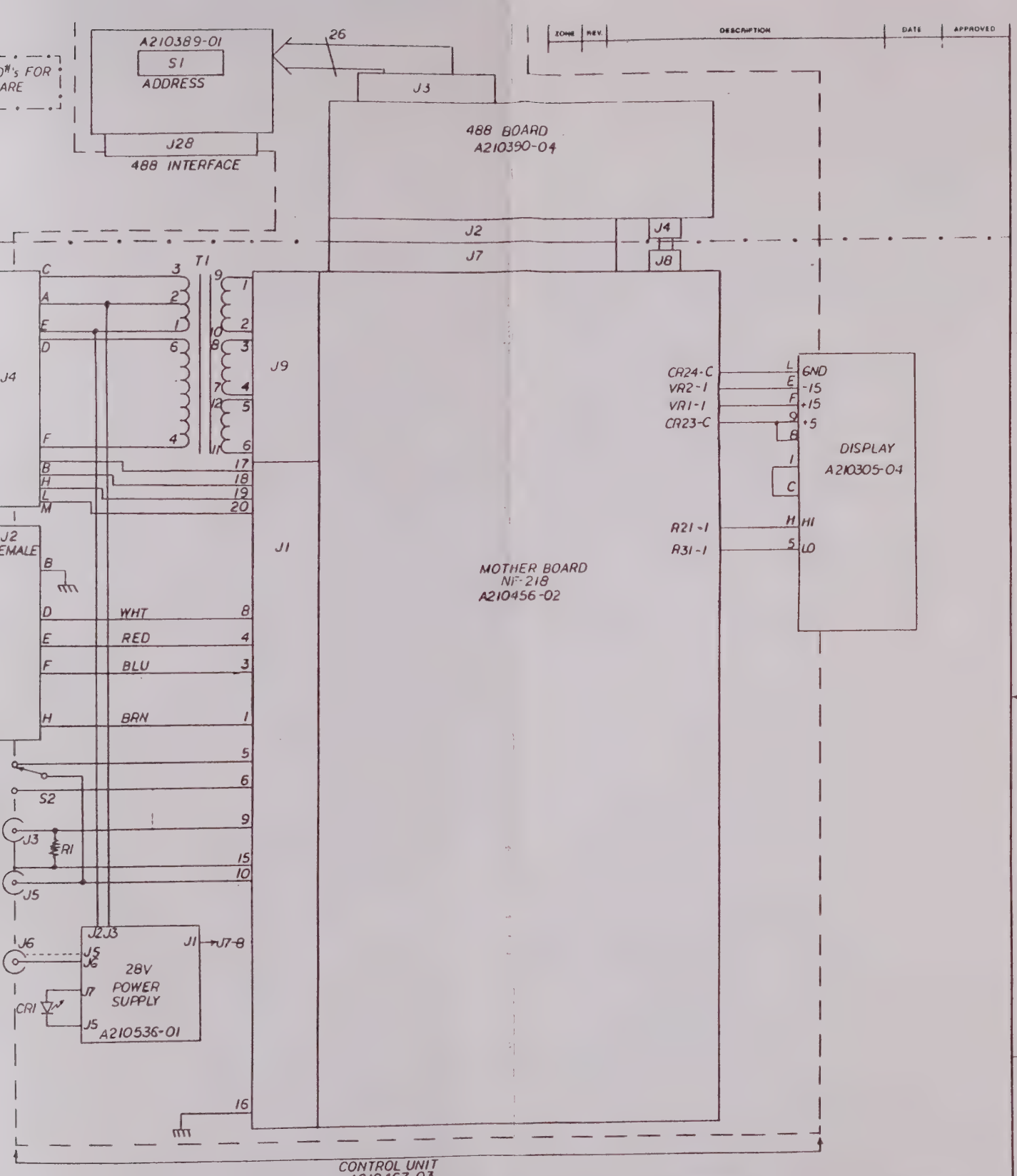
INPUT DRIVE

OUTPUT DRIVE

+28 OUT



FOR YIG FILTER
A110331-02 (NF-218)
A110450-01 (NF-052)
A110331-04 (NF-226)



ZONE	REV.	DESCRIPTION	DATE	APPROVED

QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN RLH	7-23-82
CHECKED	
ISSUED	6-17-83

INTEGRA

NF-226 INTERCONNECT

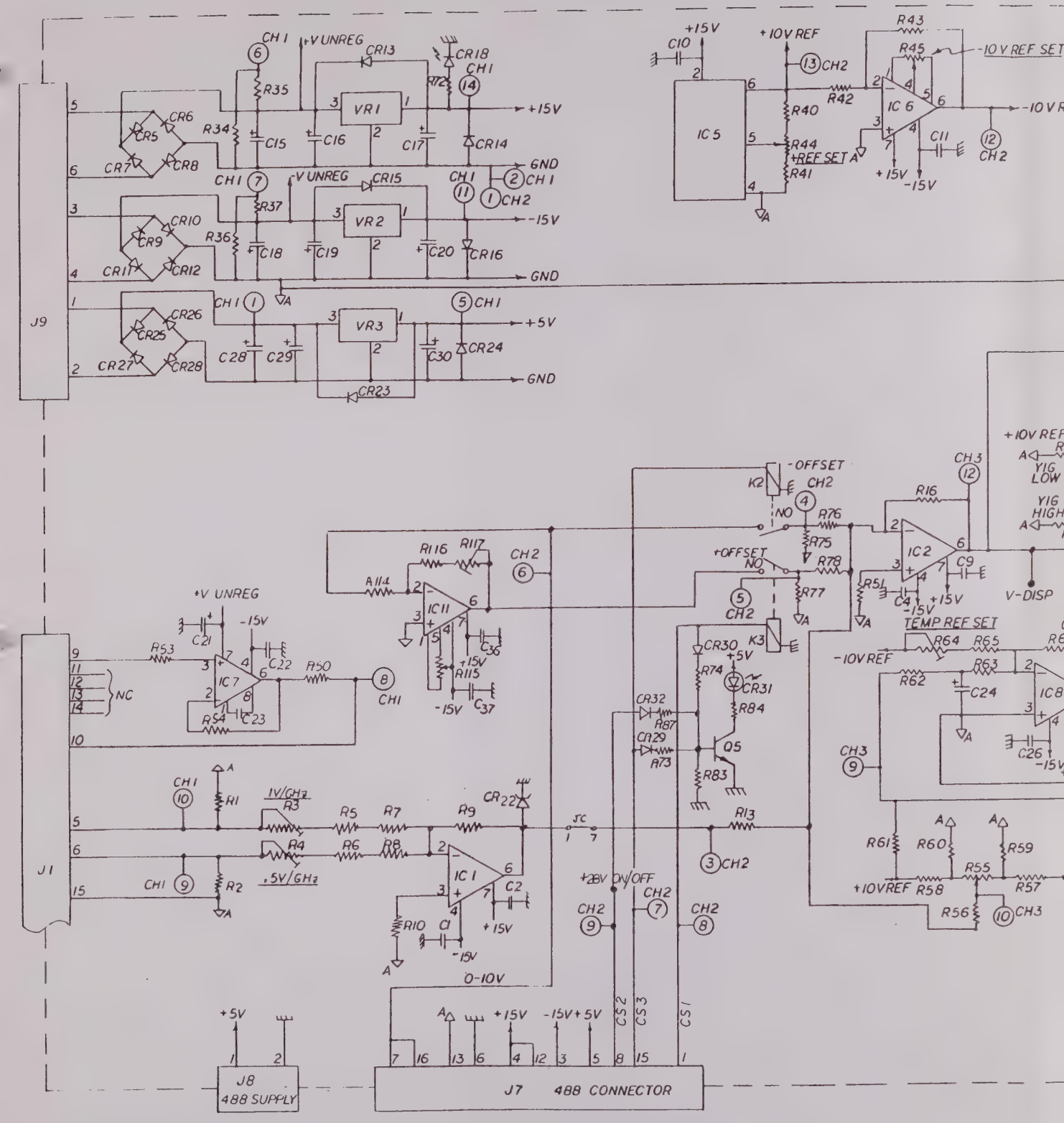
SIZE	FSCM NO.	DWG NO.	REV.
D	51162	B110537-01 -02 -03	A

SCALE

SHEET

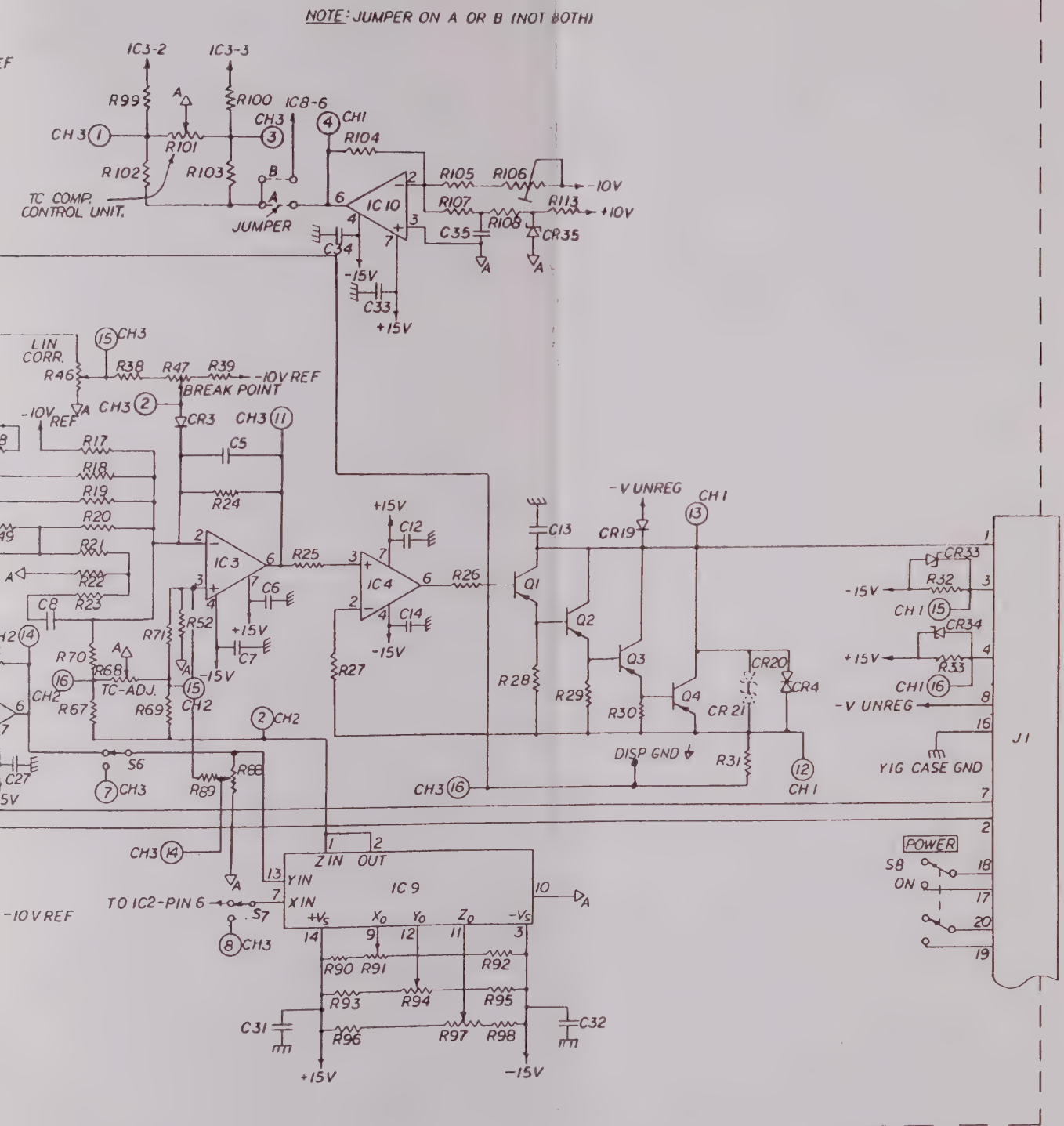
NEXT ASSY	USED ON
	NF-052
	NF-218
	NF-226

APPLICATION



LAST USED: Q5, J9, S8, VR3, IC10, C37, CR35, R117

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	ADD EXT INPUT	6-11-83	Wm. P



QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL —

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN RLH	7-27-82
CHECKED Wm. P.	8-27-82
ISSUED Wm. P	6-10-83

INTEGRA

MOTHER BOARD NF-226
UNIT (11 up)

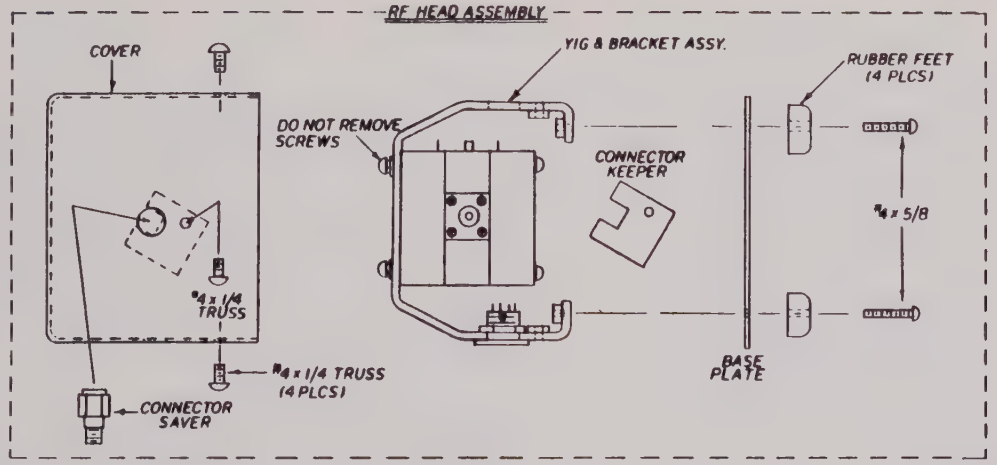
SIZE	FSCM NO.	DWG. NO	REV
D	51162	B110456-02	A

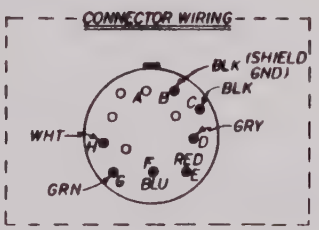
SCALE — SHEET

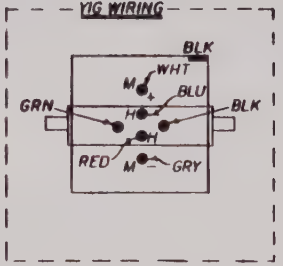
NEXT ASSY	USED ON
NF-218	
NF-XXX	

APPLICATION

4 3 2 1





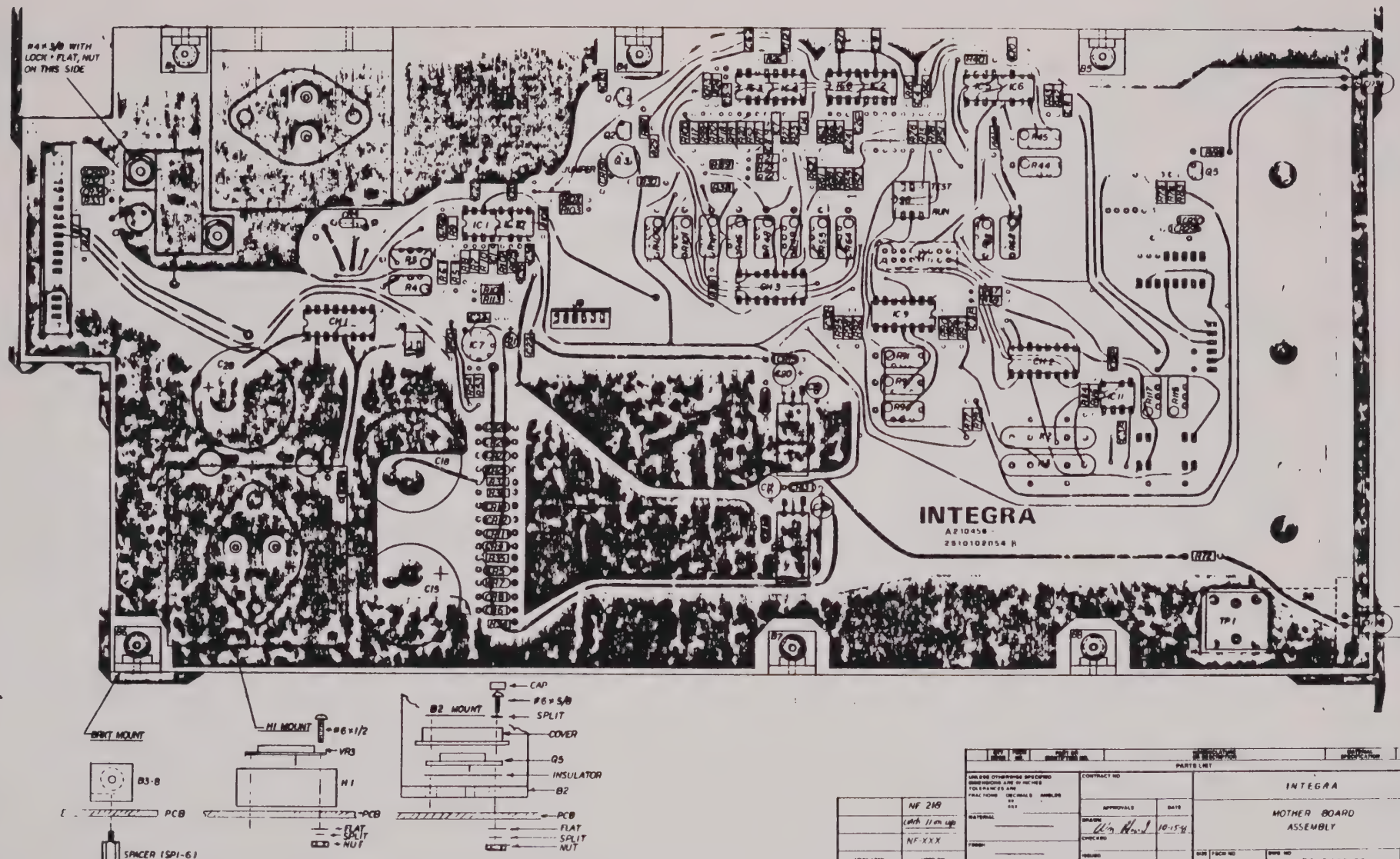


PARTS LIST				
QTY REQD	PGNO NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

TMF 1800H,J,K,L1,L2,M	
HPF-220	
NF-XXX	
NEXT ASSY	USED ON
APPLICATION	DO NOT SCALE DRAWING

CONTRACT NO		INTEGRA
APPROVALS	DATE	
DRAWN RLH	7-23-02	RF HEAD ASSEMBLY
CHECKED		
ISSUED		SIZE C · FSCM NO 51162 · DWG NO B210459-01 · REV
		SCALE · SHEET 1 OF 2

© BISHOP GRAPHICS, INC
REORDER NO. 30011



	NF 219	
	Latch 11 on up	
	NF-XXX	
NEXT ASSY	USED ON	

APPLICATION

DO NOT SCALE DRAWING

PARTS LIST

CONTRACT NO

APPROVALS	DATE
DRAWN Wm Hood	10-15-4
CHECKED	
ISSUED	

MATERIAL

FINISH

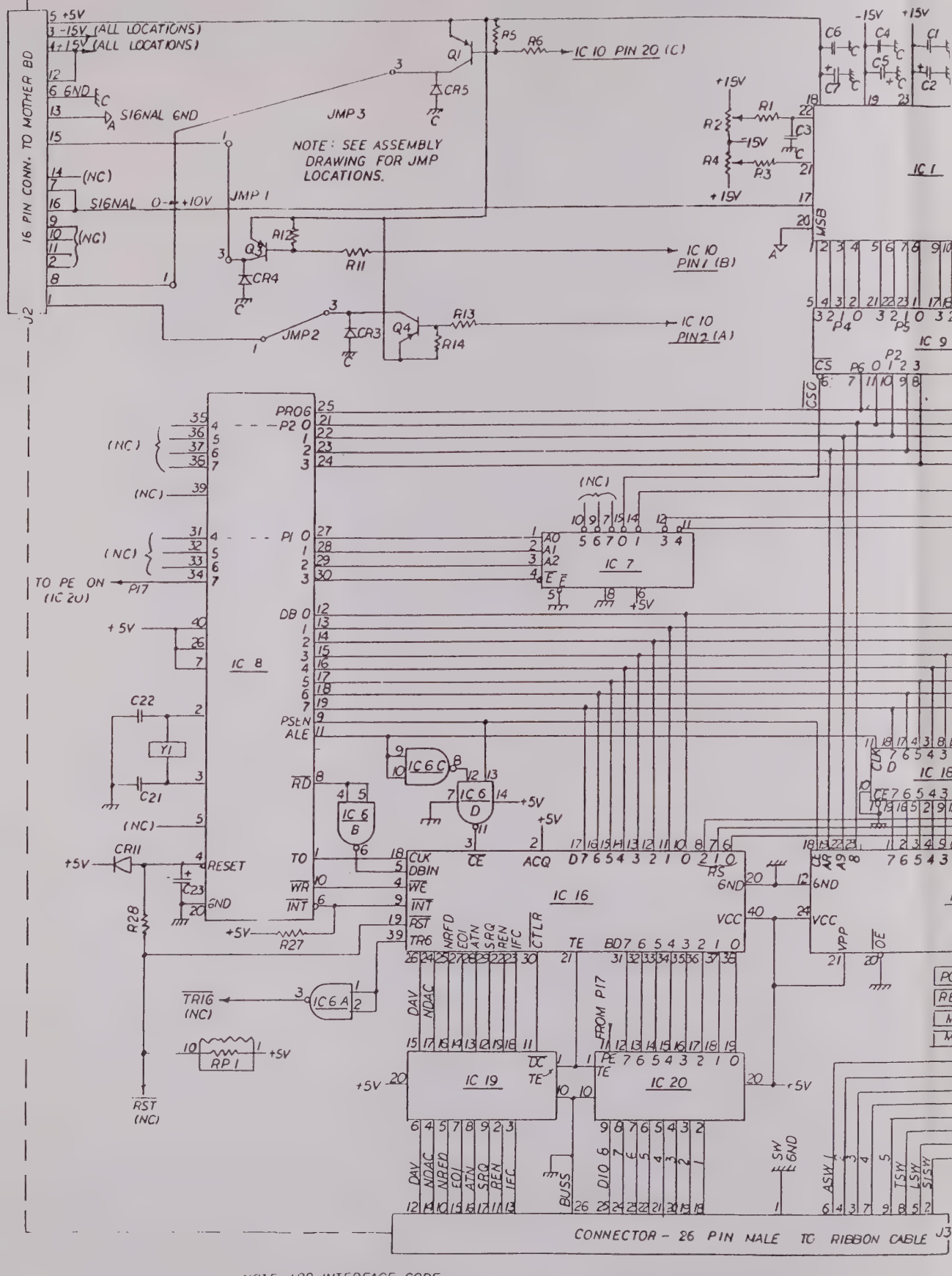
INTEGRA

MOTHER BOARD ASSEMBLY

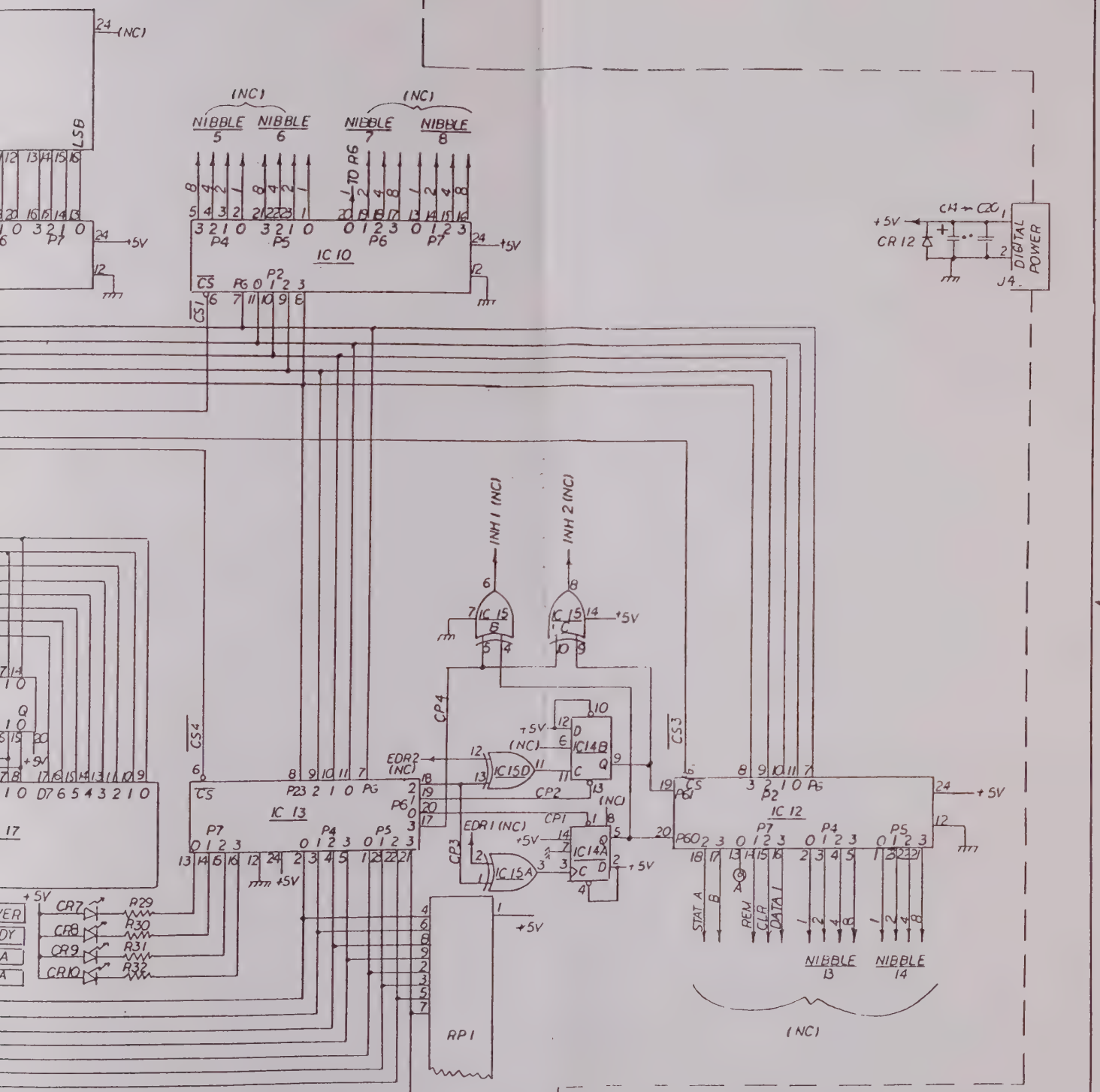
SIZE	FSCM NO	DWG NO	REV
D	51162	B210456-02	A

SCALE

SHEET


16 PIN CONN. TO MOTHER BD
J2
+5V
-15V (ALL LOCATIONS)
+15V (ALL LOCATIONS)
6 GND
SIGNAL GND
(NC)
SIGNAL 0-+10V
JMP 1
JMP 2
JMP 3
NOTE: SEE ASSEMBLY DRAWING FOR JMP LOCATIONS.
Q1
Q3
Q4
CR3
CR4
CR5
R5
R6
R11
R12
R13
R14
IC 10 PIN 20 (C)
IC 10 PIN 1 (B)
IC 10 PIN 2 (A)
C6
C4
C1
C5
C7
C2
R1
R2
R3
R4
C3
IC 1
MSB
IC 9
IC 8
PROG
P2
P1
DB
PSEN
ALE
RD
WR
INT
RST
TO
TR6
RESET
GND
C22
C21
Y1
CR11
R28
R27
TO PE ON (IC 20)
P17
IC 7
IC 6 A
IC 6 B
IC 6 C
IC 6 D
IC 16
IC 19
IC 20
CUK
DBIN
WE
CE
ACQ
RS
VCC
VPP
OE
TE
DC
DAV
NDAC
NRFD
EOI
ATN
SRQ
REN
IFC
CTLR
BUSS
FROM P17
TRIG
RP 1
CONNECTOR - 26 PIN MALE TO RIBBON CABLE
J3
NOTE: 488 INTERFACE CODE
CODE: XXXX ABC
GIVES 0-+10V
LAST USED: IC20, R32,

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
6-D	A	ECO 0167	10-6-82	Wm V
	C	ADDED DIODE CR12 + TP2	2-2-83	



QTY REQD	FSCM NO.	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

DWM-1800	TMF-1800H
HPF-220	TMF-1800K
TMF-18001	NF-XXX
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
± .XX ± ±
.XXX ±

MATERIAL —
FINISH —
DO NOT SCALE DRAWING

CONTRACT NO

APPROVALS	DATE
DRAWN Wm.	11-14-81
CHECKED	
ISSUED	

INTEGRA

IEEE 488 INTERFACE BOARD

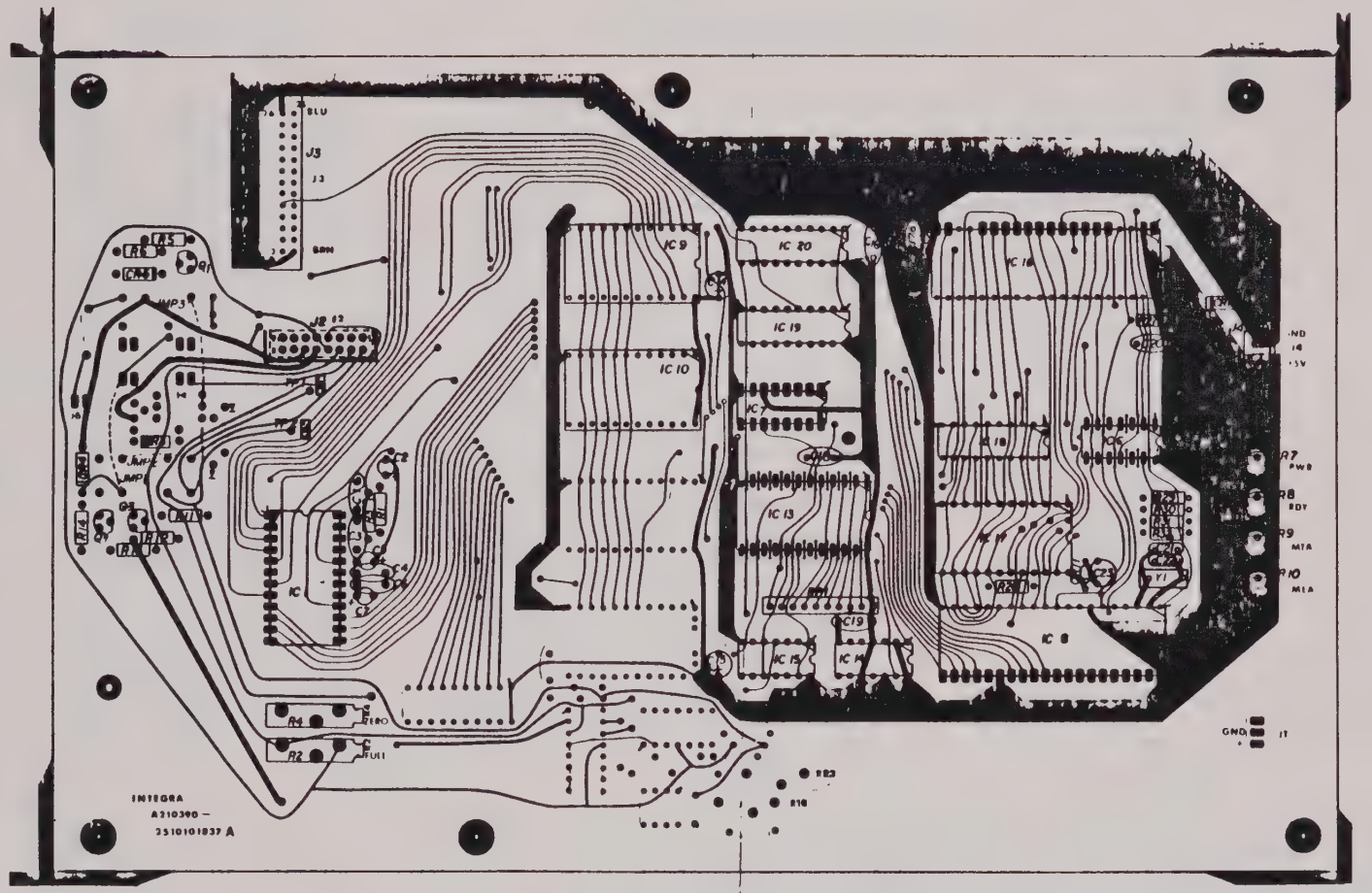
SIZE D | FSCM NO 51162 | DWG NO B110390-04 | REV C

SCALE — | SHEET 1 OF 1

3, CR12, Y1, RP1, J5

4 3 2 1

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
4,5,6	A	ECO CK7	10 2 82	[illegible]
	C	ADDED DIODE CR12 + TP2	2-2-83	



LAST USED: IC20,R32,C23,CR12,Y1,RP1,J5

DWW-1800	TMF-1800H
HPF-220	TMF-1800K
TMF-1800L	NF-XXX

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

PARTS LIST

CONTRACT NO

APPROVALS | DATE

DRAWN | 4-14-81

CHECKED

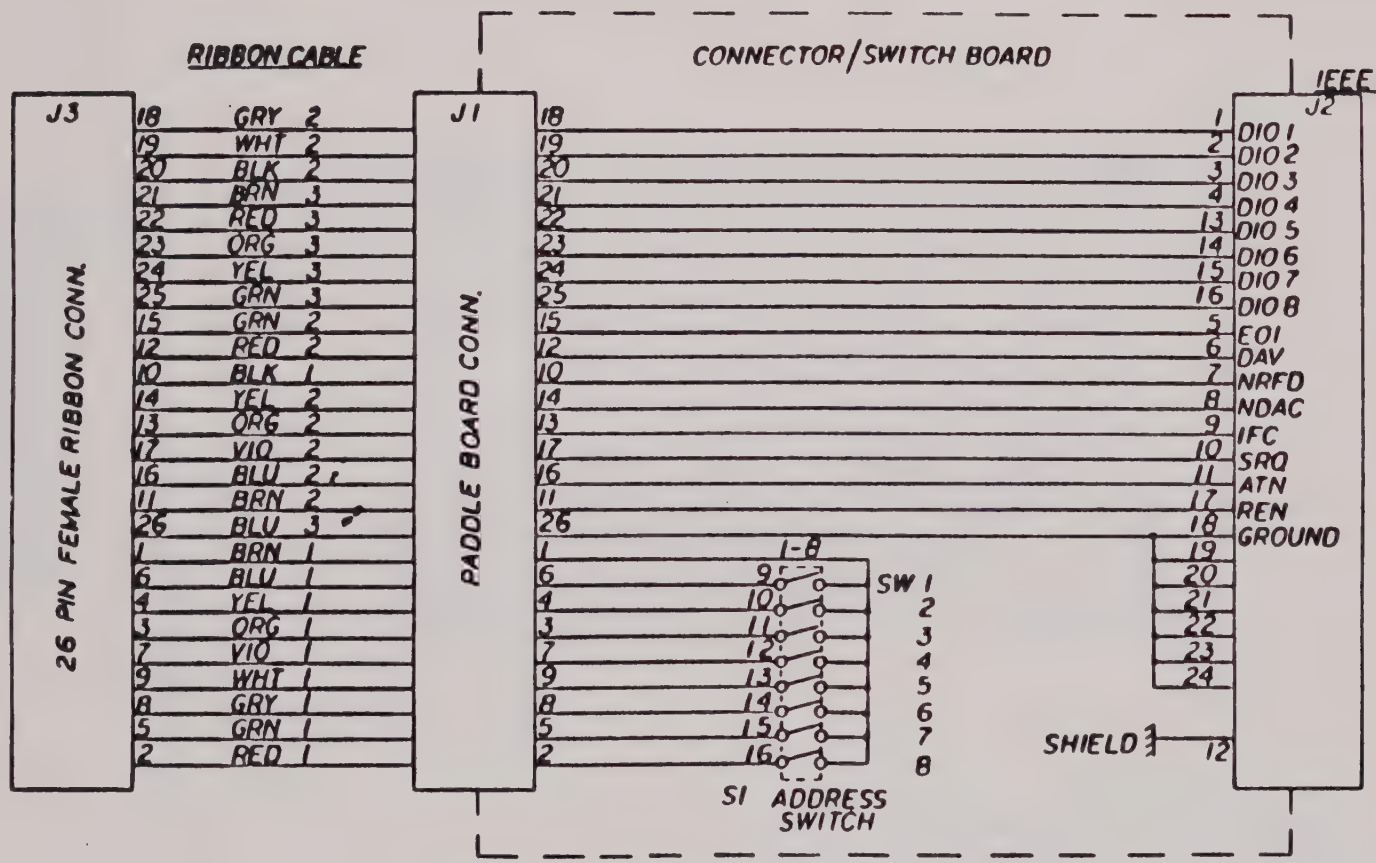
ENGR'D

INTEGRA

IEEE 488 INTERFACE BOARD

SIZE D | FSCM NO 51162 | DWG NO B210390-04 | REV C

SCALE 2/1 | SHEET 1 OF 1



DWG NO | SH | REV

REVISIONS

REV	DESCRIPTION	DATE	APPROVED

PARTS LIST

QTY PER UNIT	ITEM NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
± .XX ± .XXX ±

CONTRACT NO

APPROVALS	DATE
DRAWN RLH	7-27-82
CHECKED	
ISSUED	

MATERIAL

FINISH

NEXT ASSY | USED ON

APPLICATION | ALL INST. WITH 488

NOT SCALE DRAWING

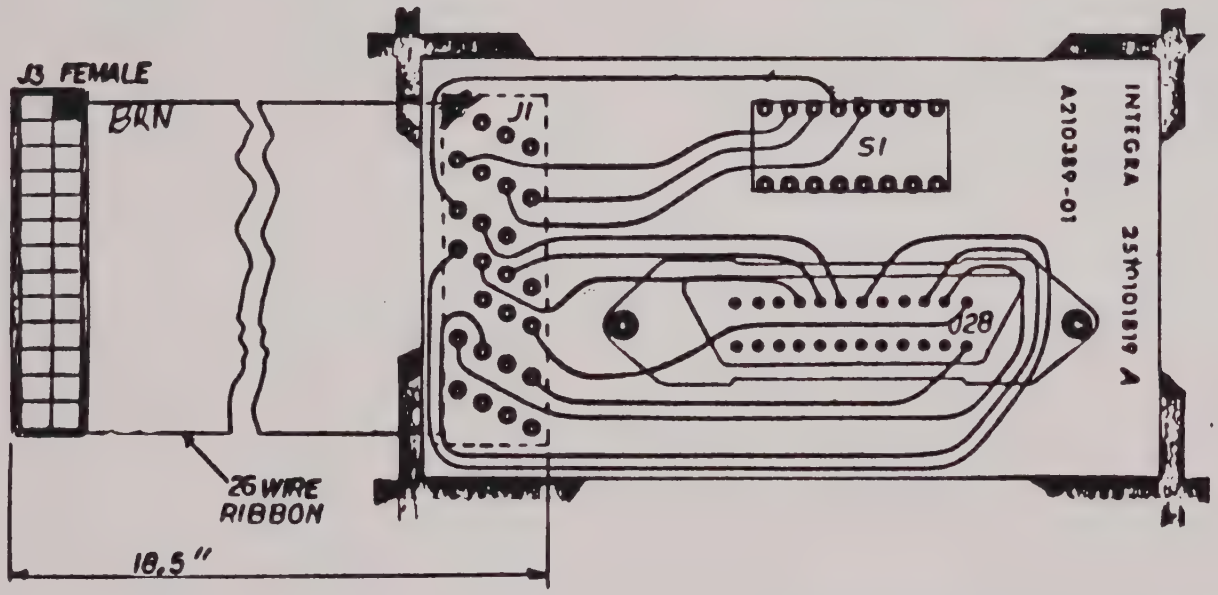
INTEGRA

488 PADDLE BOARD SCHEMATIC

SIZE	FSCM NO	DWG NO	REV
B	51162	B110389-01	

SCALE

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



QTY REQD	FSCM NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
			PARTS LIST	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE: FRACTIONS ±, DECIMALS .XX ±, .XXX ±, ANGLES ±

CONTRACT NO.

INTEGRA

CONNECTOR/SWITCH BOARD

	APPROVALS	DATE
	DRAWN RH	7-9-81
	CHECKED	7-9-81
	ISSUED	
		7-9-81

SIZE	FSCM NO.	DWG. NO.	REV
B	51162	B210389-01	A

SCALE 2~1 SHEET

	TMF 1800
	DMM 1800
	TMF 1800H
	NF-226
APPLICATION	DO NOT SCALE DRAWING

MATERIAL —

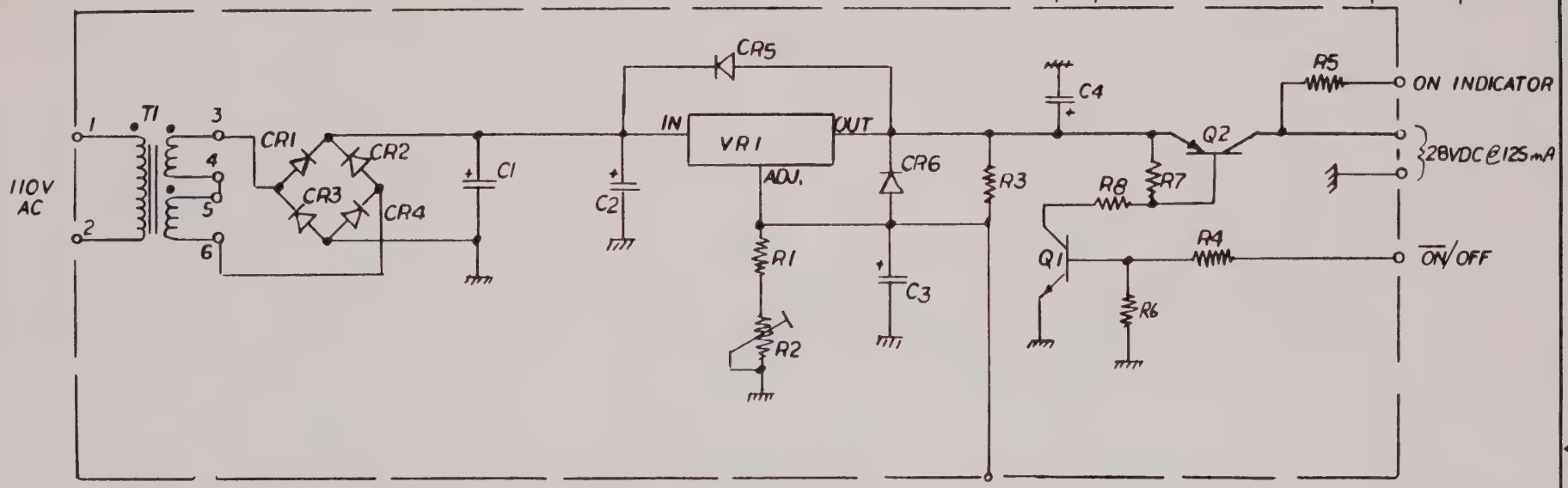
FINISH —

Printed Graphics, Inc. Project No. 8614

DWG. NO.	SH	REV.

REVISIONS

REV	DESCRIPTION	DATE	APPROVED



QTY REQD	FSCM NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
.XX ±
.XXX ±

CONTRACT NO

	APPROVALS	DATE
DRAWN		4 23 84
CHECKED		
ISSUED		

MATERIAL

FINISH

DO NOT SCALE DRAWING

	NF-XXX
NEXT ASSY	USED ON
APPLICATION	

INTEGRA

POWER SUPPLY

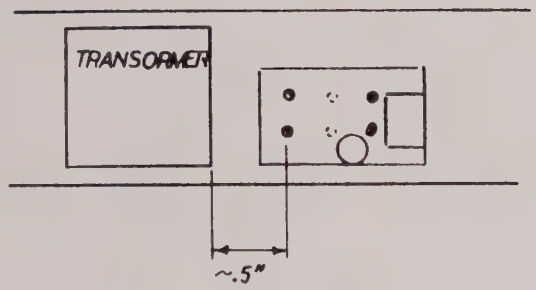
SIZE	FSCM NO.	DWG. NO.	REV
B	51162	B110536-01	A

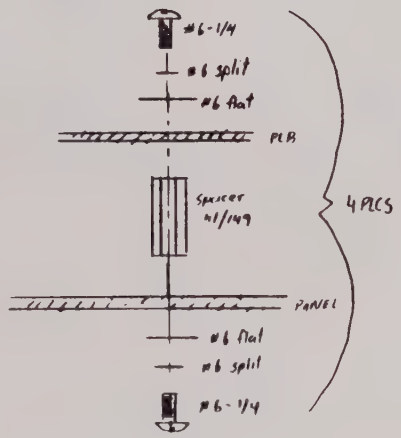
SCALE SHEET

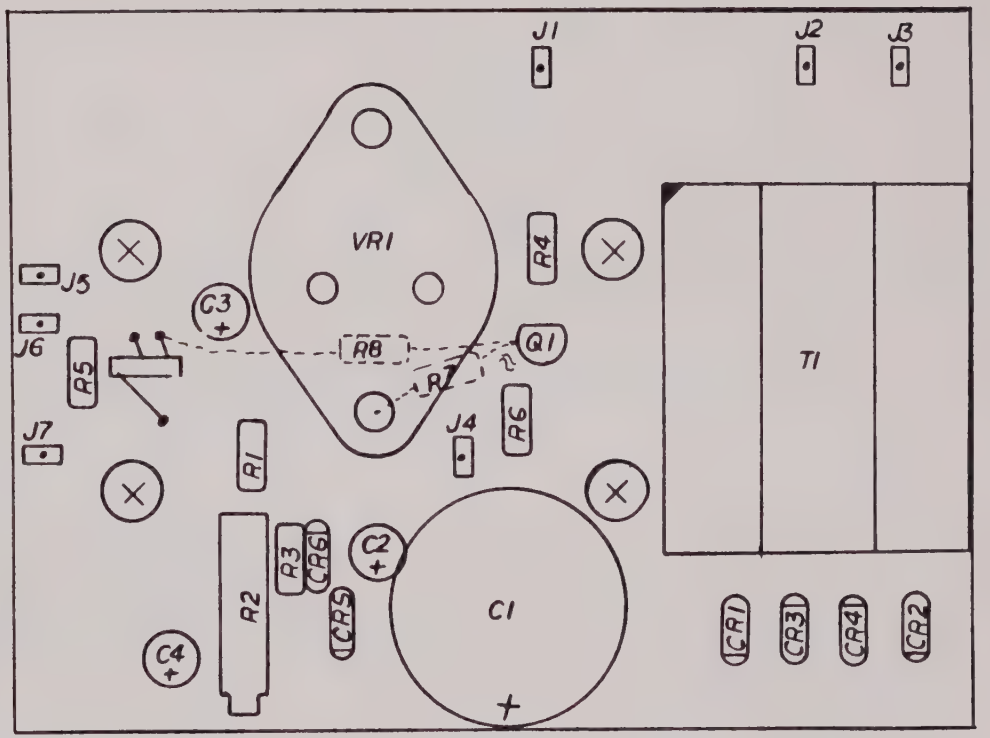
BISHOP GRAPHICS INC
REORDER NO 20510

DWG. NO.	SH	REV.

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED







	QTY REQD	FSCM NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

NEXT ASSY	USED ON
NF-XXX	
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
.XX ±
.XXX ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO

APPROVALS	DATE
DRAWN	5-25-83
CHECKED	
ISSUED	

INTEGRA

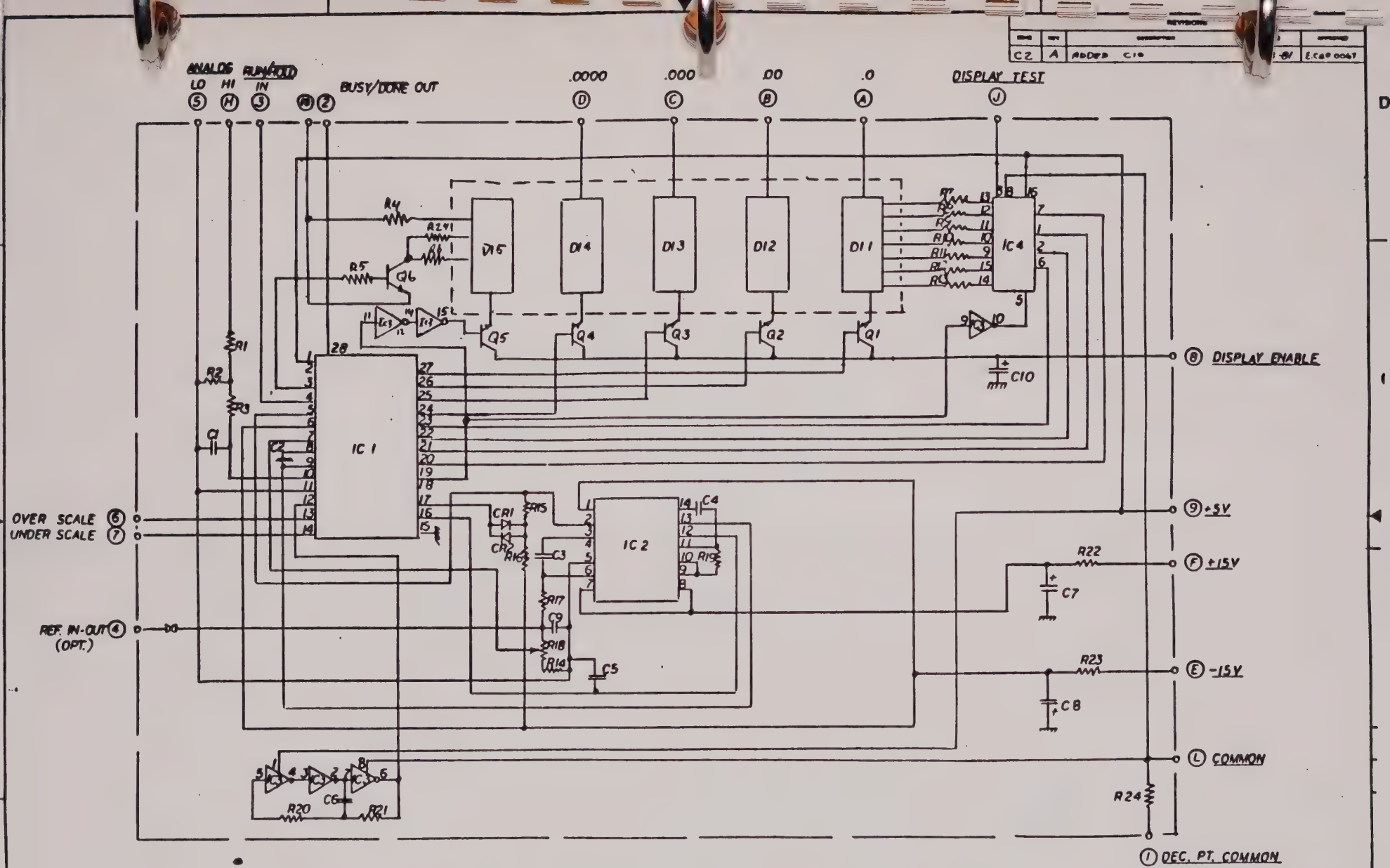
POWER SUPPLY

SIZE	FSCM NO	DWG. NO.	REV.
B	51162	B210536-01	A

SCALE

SHEET

BISHOP GRAPHICS INC
REORDER NO. 20510



NOTE:
-02 REMOVE R2 (VTS-1021
-03 REMOVE Q1 (UTS-3742), (NF-YYx)
-04 " "

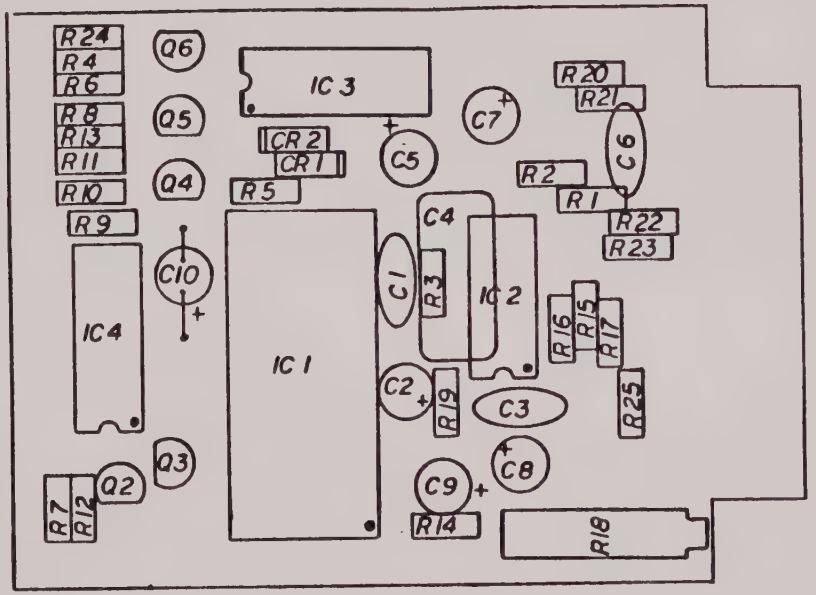
LAST USED: R24, Q6, C10, IC4, CR2

	NF-XXX
APPLICATION	DO NOT SCALE DRAWING

PARTS LIST

	INTEERA
	DVM CONVERTER
SIZE C	FSCM NO 51162
DWG NO	B110274-01
REV	A
SCALE	SHEET

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	ADDED C10	10-13-81	E.C.O.# 0067



QTY REQD	FSCM NO	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

	NF - XXX
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE.
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN PM	9.12.80
CHECKED Dallas McElveen	10-13-81
ISSUED H. Schmidt	11-5-81

INTEGRA

CONVERTER BD

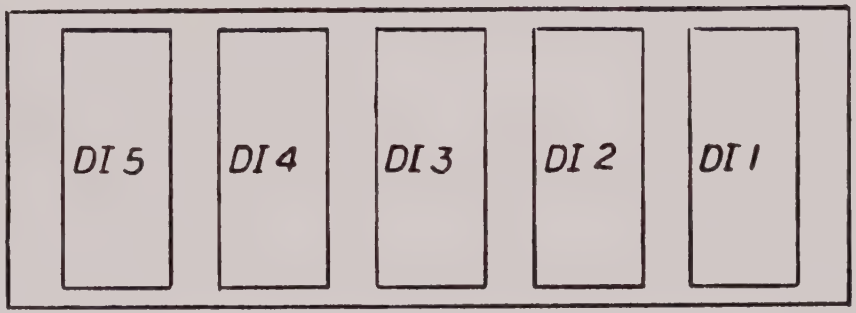
SIZE	FSCM NO.	DWG. NO.	REV.
B	51162	B210274-03,04	A

SCALE | SHEET

BISHOP GRAPHICS, INC. REORDER NO 20510

DWG. NO.	REV

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED



	QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION	

PARTS LIST

	VTS-101
	VTS-102
	NF-XXX
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL —

FINISH —

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN PM	9.12.80
CHECKED	
ISSUED	7-6-83

INTEGRA

DISPLAY BD.

SIZE	FSCM NO.	DWG. NO.	REV.
A	51162	B210275-01	

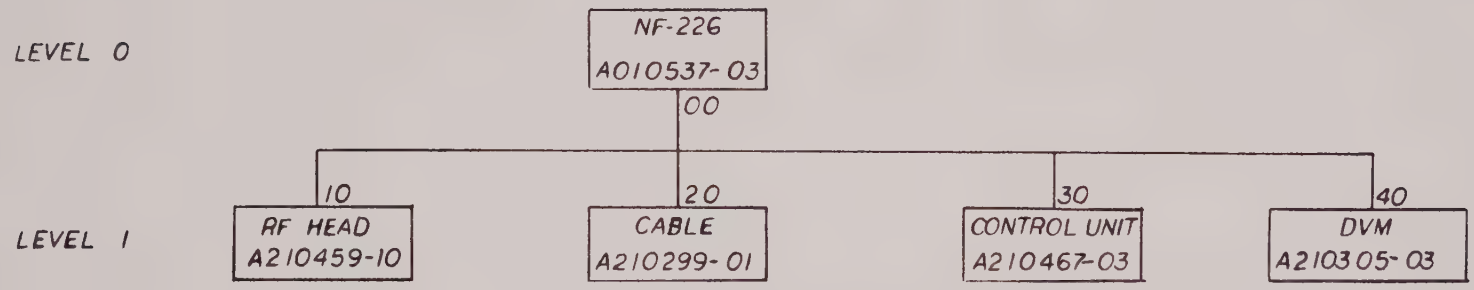
SCALE | SHEET

BISHOP GRAPHICS, INC.
REORDER NO. 20509

7.0 PARTS LIST

DWG. NO.	SH	REV.

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



	QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION	
PARTS LIST						

	NF-226
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO

APPROVALS	DATE
DRAWN	9-14-84
CHECKED	
ISSUED	

INTEGRA

PRODUCT STRUCTURE

SIZE	FSCM NO.	DWG. NO.	REV.
B	51162	B710537-03	

SCALE | SHEET

BISHOP GRAPHICS, INC
REORDER NO 20510

INTEGRA INC.
ENGINEERING PARTS LIST

ASSEMBLY # A010537-03
USED ON NF-226
NEXT ASSEMBLY END ITEM
TITLE NF-226

1 2 TC	DATE	7 CC	9 PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
		A0	10537-03			NF-226	010	E	C	0001			00	0	END ITEM	5
		B6	10102455			MANUAL	010	E	7	0001			00	1	10537-03	5
		31	10100137			AC PWR CORD	010	E	7	0001			00	1	10537-03	5
		41	10101619			LABEL S/N	010	E	7	0001			00	1	10537-03	5
		54	10101711			SHIPPING CONTAINER	010	E	7	0001			00	1	10537-03	5
		40	10102351			BLANK TAPE	010	E	7	0001			00	1	10102381	5
		34	10102381			NF-226 PROGRAM	010	E	7	0001			00	1	10537-03	5

INTEGRA INC.
ENGINEERING PARTS LIST

ASSEMBLY # A210459-10
USED ON NF-226
NEXT ASSEMBLY A010537-03
TITLE RF HEAD ASSEMBLY

1 2 TC	DATE	7 9 CC	PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
		A2	10459-10			RF HEAD ASSEMBLY	010	E	C	0001			10	1	10537-03	5
		A2	10331-04			YIG FILTER	010	E	S	0001			10	2	10459-10	5
		21	10100504			CONN SAVER	020	E	7	0001			10	2	10459-10	5
		31	10101673			WIRE, #24 ORG	050	I	7	0001			10	2	10459-10	5
		31	10101675			WIRE, #24 GRN	050	I	7	0001			10	2	10459-10	5
		31	10101676			WIRE, #24 BLU	050	I	7	0001			10	2	10459-10	5
		31	10101678			WIRE, #24 GRY	050	I	7	0001			10	2	10459-10	5
		31	10101679			WIRE, #24 WHT	050	I	7	0001			10	2	10459-10	5
		31	10101680			WIRE, #24 BLK	050	I	7	0001			10	2	10459-10	5
		31	10101681			WIRE, #24 RED	050	I	7	0001			10	2	10459-10	5
		41	10100236			WRAP, TIE	020	E	7	0001			10	2	10459-10	5
		41	10100520			CAN	010	E	7	0001			10	2	10102068	5
		41	10101381			CONN	010	E	7	0001			10	2	10459-10	5
		41	10101619			LABEL S/N	010	E	7	0001			10	2	10459-10	5
		41	10102094			RUBBER BUMPERS	040	E	7	0001			10	2	10459-10	5
		42	10004-03			SCREWS 4-40 X 3/8	040	E	7	0001			10	2	10459-10	5
		42	10102095			SCREWS 4-40 X 1/4	060	E	7	0001			10	2	10459-10	5
		52	10102069			LABEL PROD ID	010	E	7	0001			10	2	10459-10	5
		52	10102070			LABEL RF-INPUT	010	E	7	0001			10	2	10459-10	5
		52	10102112			LABEL RF-OUTPUT	010	E	7	0001			10	2	10459-10	5
		72	10102060			YIG HOLDER	010	E	7	0001			10	2	10459-10	5
		72	10102067			PLATE	010	E	7	0001			10	2	10459-10	5
		72	10102068			COVER, RF HEAD	010	E	2	0001			10	2	10459-10	5
		72	10100450			PLATE, LOCK	020	E	3	0001			10	2	10459-10	5
		72	10100929			PLATE, ALUM	020	E	7	0001			10	2	10100450	5

INTEGRA I.
ENGINEERING PARTS LIST

ASSEMBLY # A210299-01
USED ON NF-226
NEXT ASSEMBLY A010537-03
TITLE CABLE, INTERCONNECT

1 2 TC	DATE	7 9 CC	PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
		A2	10299-01			CABLE, INTERCONNECT	010	E	C	0001			20	1	10537-03	5
		31	10101509			CABLE	050	F	7	0001			20	2	10299-01	5
		41	10101380			CONN	020	E	7	0001			20	2	10299-01	5

INTEGRA INC.
ENGINEERING PARTS LIST

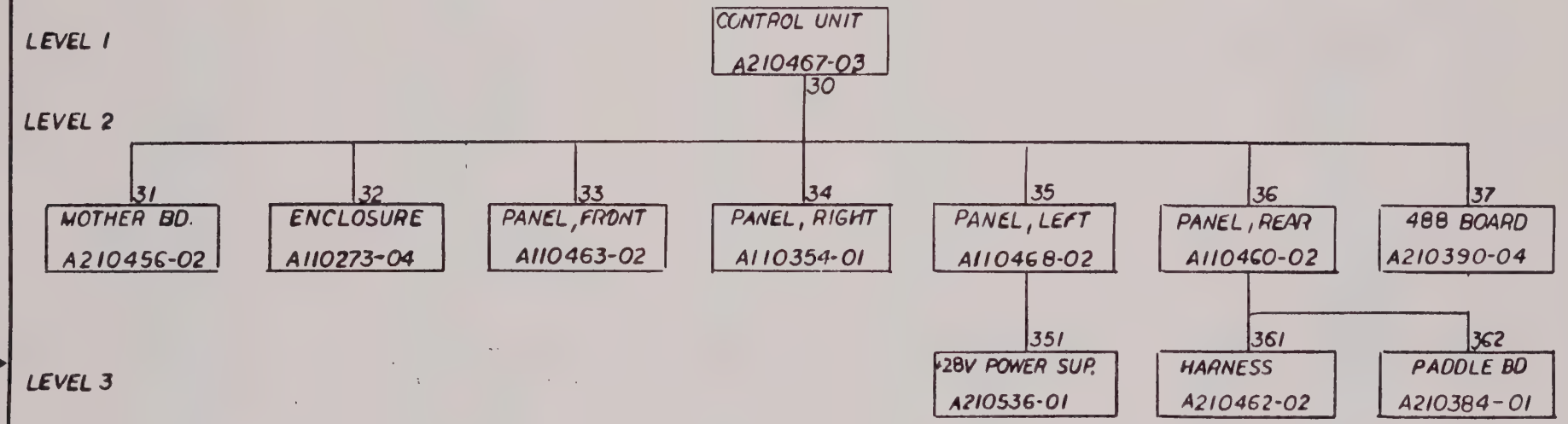
ASSEMBLY # A210467-03
USED ON NF-226
NEXT ASSEMBLY A010537-03
TITLE NF-CONTROL UNIT

1 2 TC	DATE	7 CC	9 PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
		A2	10467-03		A	CONTROL UNIT	010	E	C	0001			30	1	10537-03	5
		41	10100278			WASHER, NYLON	080	E	9	0001			30	2	10467-03	5
		41	10100281			RETAINER, STRAP	040	E	9	0001			30	2	10101776	5
		41	10100283			FEET	040	E	9	0001			30	2	10467-03	5
		41	10100470			EXTRU, FRONT	020	E	9	0001			30	2	10467-03	5
		41	10101224			PANEL,DECORATIVE	020	E	9	0001			30	2	10467-03	5
		41	10101225			STRAP	020	E	9	0001			30	2	10467-03	5
		41	10101582			COVER, TOP	010	E	9	0001			30	2	10467-03	5
		41	10101583			COVER, BOTTOM	010	E	9	0001			30	2	10467-03	5
		41	10101776			RETAINER, STRAP	040	E	3	0001			30	2	10467-03	5
		42	10007-04			SCREW, #6-1/2	060	E	9	0034			30	2	10467-03	5
		42	10303-16			SCREW, #6-3/4, BLK	040	E	7	0001			30	2	10467-03	5
		42	10100277			SCREW, #6-3/4	080	E	9	0001			30	2	10467-03	5
		42	10100284			SCREW, #6-ST	050	E	9	0001			30	2	10467-03	5
		42	10100334			NUT, HEX #8	040	E	9	0001			30	2	10467-03	5
		42	10100335			SCREW, SPOTWELD	040	E	9	0001			30	2	10467-03	5
		42	10100337			SCREW, #8-1/2	040	E	9	0001			30	2	10467-03	5
		43	10100074			WASH, #6 FL	100	E	7	0001			30	2	10467-03	5
		43	10100075			WASH, #6 SPL	100	E	7	0001			30	2	10467-03	5

DWG. NO.	SH	REV.

REVISIONS

REV.	DESCRIPTION	DATE	APPROVED



QTY REQD	FSCM NO	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

CONTRACT NO.

APPROVALS	DATE
DRAWN	
CHECKED	
ISSUED Wm. Hind	6-16-83

INTEGRA

PRODUCT STRUCTURE

SIZE	FSCM NO.	DWG. NO.	REV.
B	51162	B710467-03	

SCALE | SHEET

	NF-XXX
NEXT ASSY	USED ON

APPLICATION

DO NOT SCALE DRAWING

BISHOP GRAPHICS, INC
REORDER NO 20510

INTEGRA
ENGINEERIN PARTS LIST

ASSEMBLY # A210456-03
USED ON NF-226
NEXT ASSEMBLY A010467-03
TITLE MOTHER BOARD

1 2 TC	7 DATE	9 CC	PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
		A2	10456-03		B	MOTHER BD.	010	E	7	0001			31	2	10467-03	5
		13	10100434			C MICA 91 PF	010	E	7	0001	C 23		31	3	10456-03	5
		13	10100543			C CER .01uF	140	E	7	0001	C 1,2,4,6,7,9-14, 22,36,37		31	3	10456-03	5
		13	10101900			C ELECT 10uF 25V	040	E	7	0001	C 17,20,21,30		31	3	10456-03	5
		13	10101901			C ELECT, 1uF 50V	030	E	7	0001	C 16,19,29		31	3	10456-03	5
		13	10102164			CAP ELEC 4700uF	030	E	7	0001	C 15,18,28		31	3	10456-03	5
		15	10100016			DIODE 5.1V	020	E	7	0001	CR 33,34		31	3	10456-03	5
		15	10100019			DIODE IN4148	040	E	7	0001	CR 3,29,30,32		31	3	10456-03	5
		15	10101137			DIODE IN6159	010	E	7	0001	CR 4		31	3	10456-03	5
		15	10101633			DIODE IN4004	190	E	7	0001	CR 5-16,19,23-28		31	3	10456-03	5
		17	10100383			LED, YEL	010	E	7	0001	CR 31		31	3	10456-03	5
		17	10100384			LED, GREEN	010	E	7	0001	CR 18		31	3	10456-03	5
		19	10100045			IC LIN	010	E	7	0001	VR 3		31	3	10456-03	5
		19	10100114			IC LIN LM741	020	E	7	0001	IC 6,11		31	3	10456-03	5
		19	10100116			IC LIN LM307	040	E	7	0001	IC 1-4		31	3	10456-03	5
		19	10100741			IC LIN REF-01	010	E	7	0001	IC 5		31	3	10456-03	5
		19	10101637			IC LIN +15V 7815	010	E	7	0001	VR 1		31	3	10456-03	5
		19	10101638			IC LIN -15V 7915	010	E	7	0001	VR 2		31	3	10456-03	5
		19	10102059			IC LM 344	010	E	7	0001	IC 7		31	3	10456-03	5
		25	10102054		B	PCB	010	E	7	0001			31	3	10456-03	5
		26	10100785			RELAY	020	E	7	0001	K 2,3		31	3	10456-03	5
		27	10100110			R CARB 10K	040	E	7	0001	R 73,74,83,87		31	3	10456-03	5
		27	10100190			R MF 100	020	E	7	0001	R 32,33		31	3	10456-03	5
		27	10100286			R MF 20.0K	060	E	7	0001	R 34-37,57,58		31	3	10456-03	5
		27	10100288			R MF 14.7K	010	E	7	0001	R 20		31	3	10456-03	5
		27	10100289			R MF 10.0K	020	E	7	0001	R 29,51		31	3	10456-03	5
		27	10100436			R MF 49.9K	040	E	7	0001	R 1,2,53,54		31	3	10456-03	5
		27	10102135			R MF 909	010	E	7	0001	R 7,20A		31	3	10456-03	5
		27	10100465			R CARB 1 OHM	010	E	7	0001	R 50		31	3	10456-03	5
		27	10100466			R WW 3 OHM 1% 25W	010	E	7	0001	R 31		31	3	10456-03	5
		27	10100583			R MF 301K	010	E	7	0001	R 19		31	3	10456-03	5
		27	10100585			R MF 39.2K	010	E	7	0001	R 40		31	3	10456-03	5
		27	10100599			R MF 100K	030	E	7	0001	R 28,75,77		31	3	10456-03	5
		27	10100601			R MF 7.50K	010	E	7	0001	R 10		31	3	10456-03	5
		27	10100602			R MF 3.01K	020	E	7	0001	R 24,52		31	3	10456-03	5
		27	10100609			R MF 1.00 M	050	E	7	0001	R 56		31	3	10456-03	5
		27	10100610			R MF 1.00 K	080	E	7	0001	R 25-27,30,41,59,60,72		31	3	10456-03	5
		27	10100743			R CARB 510	010	E	7	0001	R 84		31	3	10456-03	5

INTEGRA
ENGINEERING PARTS LIST

ASSEMBLY # A210456-03
USED ON NF-226
NEXT ASSEMBLY A010467-03
TITLE MOTHER BOARD

1 2 TC DATE	7 9 CC PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
	27 10100820			R MF 200K	010	E	7	0001	R 18		31	3	10456-03	5
	27 10100995			R MF 10	010	E	7	0001	R 8		31	3	10456-03	5
	27 10101088			R MF 19.1K	010	E	7	0001	R 116		31	3	10456-03	5
	27 10101271			R MF 26.1K	010	E	7	0001	R 6		31	3	10456-03	5
	27 10101384			R CARB 6.2M	010	E	7	0001	R 39		31	3	10456-03	5
	27 10101385			R MF 20.0K .1%	010	E	7	0001	R 13,16,42,43, 76,78,114		31	3	10456-03	5
	27 10101404			R MF 237K	010	E	7	0001	R 9					
	27 10102080			R MF 402K	010	E	7	0001	R 17		31	3	10456-03	5
	27 10102214			R MF 1.2M	010	E	7	0001	R 38		31	3	10456-03	5
	27 10101274			R MF 51.1K	010	E	7	0001	R 5		31	3	10456-03	5
	28 10101960			R VAR 1K	010	E	7	0001	R 4		31	3	10456-03	5
	28 10101961			R VAR 2K	020	E	7	0001	R 3,117		31	3	10456-03	5
	28 10101962			R VAR 10K	040	E	7	0001	R 44,45,55,115		31	3	10456-03	5
	28 10101964			R VAR 100K	040	E	7	0001	R 46-49		31	3	10456-03	5
	30 10100092			TRANSISTOR NPN	010	E	7	0001	Q 5		31	3	10456-03	5
	30 10100196			TRANS, 2N5401	020	E	7	0001	Q 1,2		31	3	10456-03	5
	30 10100233			TRANS, MM4001	010	E	7	0001	Q 3		31	3	10456-03	5
	30 10100237			TRANS, 2N6228	010	E	7	0001	Q 4		31	3	10456-03	5
	41 10100124			SOCKET 8 PIN	030	E	7	0001			31	3	10456-03	5
	41 10100128			SOCKET 16 PIN	050	E	7	0001			31	3	10456-03	5
	41 10100239			HEATSINK	010	E	7	0001	H 1		31	3	10456-03	5
	41 10101093			SWITCH POWER	010	E	7	0001	S 1		31	3	10456-03	5
	41 10101622			POST HEADER FRICTION LK	010	E	7	0001	J 1		31	3	10456-03	5
	41 10101624			POST HEADER FRICTION LK	010	E	7	0001	J 8		31	3	10456-03	5
	41 10101626			CONNECTOR	010	E	7	0001	J 7		31	3	10456-03	5
	41 10101631			DIP PLUG, 16 PIN	010	E	7	0001			31	3	10456-03	5
	41 10102074			POST HEADER FRICTION LK	010	E	7	0001	J 9		31	3	10456-03	5
	42 10004-02			SCREW 4-40 1/4	020	E	7	0001			31	3	10456-03	5
	42 10004-03			SCREW 4-40 3/8	020	E	7	0001			31	3	10456-03	5
	42 10007-04			SCREW 6-32 1/2	040	E	7	0001			31	3	10456-03	5
	42 10007-06			SCREW 6-32 3/4	020	E	7	0001			31	3	10456-03	5
	42 10100070			NUT #6	040	E	7	0001			31	3	10456-03	5
	42 10100175			NUT #4	040	E	7	0001			31	3	10456-03	5
	42 10101657			SPACER	060	E	7	0001			31	3	10456-03	5
	43 10100075			WASHER SPLIT	060	E	7	0001			31	3	10456-03	5
	43 10100180			WASHER SPLIT	040	E	7	0001			31	3	10456-03	5

INTEGRA
ENGINEERING PARTS LIST

ASSEMBLY # A210456-03
USED ON NF-226
NEXT ASSEMBLY A010467-03
TITLE MOTHER BOARD

1 2 TC	DATE	7 CC	9 PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
		43	10100188			INSULATOR	010	E	7	0001			31	3	10456-03	5
		50	10102143			FISH PAPER	230	I	7	0001			31	3	10102085	5
		52	10101974			MYLAR TAPE "	030	I	7	0001	TP 1		31	3	10456-03	5
		72	10101579			BRACKET PC MOUNT	060	E	7	0001	B 3-8		31	3	10456-03	5
		72	10102166			BRACKET, HEATSINK	010	E	7	0001	B 2		31	3	10456-03	5
		72	10102170			BRACKET HEATSINK	010	E	7	0001			31	3	10102166	5
		73	10102085			PROT COVER, AC POWER	010	E	3	0001			31	3	10456-03	5
		41	10100665			COVER, TRANS	010	E	7	0034			31	3	10456-03	5
		41	10100084			SOCKET, 14 PIN	010	E	7	0034			31	3	10456-03	5

INTEGRA
ENGINEERING PARTS LIST

ASSEMBLY # A110273-04
USED ON NF-226
NEXT ASSEMBLY A210467-03
TITLE ENCLOSURE

1 2 TC	DATE	7 CC	9 PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
		A1	10273-04			ENCLOSURE	010	E	7	0001			32	2	10467-03	5

INTEGRA
ENGINEERING PARTS LIST

ASSEMBLY # A110463-02
USED ON NF-226
NEXT ASSEMBLY A110467-03
TITLE PANEL FRONT

1 2 TC	DATE	7 CC	9 PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
		A1	10463-02		A	PANEL, FRONT	010	E	C	0001			32	2	10467-03	5
		17	10100382			LED	010	E	7	0001			32	3	10463-02	5
		41	10100901			ALUM, BLK	500	C	7	0001			32	2	10102062	5
		72	10102312			PANEL, FRONT	010	E	7	0001			32	3	10463-02	5
		72	10102313			LABEL, FRONT PANEL	010	E	3	0001			32	3	10463-02	5
		A2	10305-04			DISPLAY	010	E	3	0001			32	3	10463-02	5

INTEGRA[illegible]
ENGINEERING PARTS LIST

ASSEMBLY # A110354-01
USED ON NF-226
NEXT ASSEMBLY A210467-03
TITLE PANEL, SIDE RIGHT

1 2 TC	DATE	7 9 CC	PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
		A1	10354-01		A	PANEL, SIDE RT	010	E	C	0001			34	2	10467-03	5
		41	10100326			CAST, CNR FR	010	E	9	0001			34	3	10354-01	5
		41	10100327			CAST, CNR RE	010	E	9	0001			34	3	10354-01	5
		41	10101062			EXTRU, SIDE	020	E	9	0001			34	3	10354-01	5
		41	10101226			PLATE, STRU SID	010	E	9	0001			34	3	10101591	5
		41	10101591		A	PANEL, SIDE RIGHT	010	E	3	0001			34	3	10354-01	5
		42	10100332			NUT, CLIP	040	E	9	0001			34	3	10354-01	5
		42	10100333			NUT, CLIP	040	E	9	0001			34	3	10354-01	5
		42	10100334			NUT, HEX #8	040	E	9	0001			34	3	10354-01	5
		42	10100335			SCREW, SPOTWELD	040	E	9	0001			34	3	10354-01	5

INTEGRA
ENGINEERING PARTS LIST

ASSEMBLY # A110468-02
USED ON NF-226
NEXT ASSEMBLY A210467-03
TITLE PANEL, SIDE LEFT

1 2 TC	DATE	7 9 CC	PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
		A1	10468-02		A	PANEL, SIDE LF	010	E	C	0001			35	2	10467-03	5
		29	10101617			TRANSFORMER	010	E	7	0001			35	2	10468-02	5
		41	10100326			CAST,CNR FR	010	E	9	0001			35	3	10468-02	5
		41	10100327			CAST,CNR RE	010	E	9	0001			35	3	10468-02	5
		41	10101062			EXTRU,SIDE	020	E	9	0001			35	3	10468-02	5
		41	10101226			PLATE,STRU SID	010	E	9	0001			35	3	10101592	5
		41	10101592		C	PANEL, SID LF	010	E	3	0001			35	3	10468-02	5
		42	10007-02			SCREW, #6-1/4	040	E	3	0001			35	3	10468-02	5
		42	10007-04			SCREW, #6-1/2	040	E	7	0001			35	3	10468-02	5
		42	10100332			NUT, CLIP	040	E	9	0001			35	3	10468-02	5
		42	10100333			NUT, CLIP	040	E	9	0001			35	3	10468-02	5
		42	10100334			NUT, HEX #8	040	E	9	0001			35	3	10468-02	5
		42	10100335			SCREW, SPOTWELD	040	E	9	0001			35	3	10468-02	5
		43	10100074			WASH, #6 FL	080	E	7	0001			35	3	10468-02	5
		43	10100075			WASH, #6 SPL	080	E	7	0001			35	3	10468-02	5

INTEGRA
ENGINEERING PARTS LIST

ASSEMBLY # A010536-01
USED ON NF-226
NEXT ASSEMBLY A11468-03
TITLE POWER SUPPLY

1 2 TC	DATE	7 9 CC	PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
		A2	10536-01			POWER SUPPLY	010	E	C	0001			351	2	10468-03	5
		13	1010			CAP ELECT 1000 UF	010	E	7	0001	C 1		351	3	10536-01	5
		13	10101900			CAP ELECT 10 UF	020	E	7	0001	C 3,4		351	3	10536-01	5
		13	10101901			CAP ELECT 1 UF	010	E	7	0001	C 2		351	3	10536-01	5
		15	10101633			DIODE 1N4004	060	E	7	0001	CR 1-6		351	3	10536-01	5
		19	10101218			IC LIN LM371K	010	E	7	0001	VR 1		351	3	10536-01	5
		25	10102309			PCB	010	E	7	0001			351	3	10536-01	5
		27	10100094			R CARB 240	010	E	7	0001	R 3		351	2	10536-01	5
		27	10100110			R CARB 10 K	010	E	7	0001	R 7		351	2	10536-01	5
		27	10100290			R MF 4.99K	010	E	7	0001	R 1		351	3	10536-01	5
		27	10100301			R CARB 1.8K	010	E	7	0001	R 5		351	2	10536-01	5
		27	10100304			R CARB 1K	010	E	7	0001	R 4		351	2	10536-01	5
		27	10100309			R CARB 100K	010	E	7	0001	R 6		351	2	10536-01	5
		27	10100522			R CARB 4.7K	010	E	7	0001	R 8		351	2	10536-01	5
		28	10100315			R VAR 500	010	E	7	0001	R 2		351	2	10536-01	5
		29	10102311			TRANSFORMER	010	E	7	0001	T 1		351	3	10536-01	5
		30	10100092			TRANSISTOR NPN	010	E	7	0001	Q 1		351	3	10536-01	5
		30	10101433			TRANSISTOR	010	E	7	0001	Q 2		351	3	10536-01	5
		41	10100149			SPACER	040	E	7	0001			351	2	10536-01	5
		41	10101809			POST	035	E	7	0001	J 1-7		351	2	10536-01	5
		42	10007-02			SCREW 6-1/4	040	E	7	0001			351	2	10536-01	5
		43	10100074			WASHER FLAT 6	040	E	7	0001			351	2	10536-01	5
		43	10100075			WASHER SPLIT 6	040	E	7	0001			351	2	10536-01	5

INTEGRA
ENGINEERING PARTS LIST

ASSEMBLY # A110460-02
USED ON NF-226
NEXT ASSEMBLY A110467-03
TITLE PANEL REAR

1 2 TC	DATE	7 9 CC	PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
		A1	10460-02		B	PANEL, REAR	010	E	C	0001			36	2	10467-03	5
		13	10101369			C CER 1000 PF	010	E	3	0001	C1		36	3	10460-02	5
		16	10100502			FUSE, 1 AMP SB	010	E	7	0001			36	3	10460-02	5
		41	10100125			BNC	030	E	7	0011			36	3	10460-02	5
		41	10100901			ALUM, BLK	500	C	7	0001			36	3	10460-02	5
		41	10101087			RECEPT, A/C	010	E	7	0001			36	3	10460-02	5
		41	10101118			SWITCH	010	E	7	0011			36	3	10460-02	5
		41	10101381			CONN	010	E	7	0001			36	3	10460-02	5
		72	10102056			PANEL, REAR	010	E	7	0001			36	3	10460-02	5
		72	10102314			LABEL, REAR PANEL	010	E	3	0001			36	3	10460-02	5
		27	10100309			R CARB 100K	010	E	3	0001	R2		36	3	10460-02	5

INTEGRA
ENGINEERING PARTS LIST

ASSEMBLY # A210462-02
USED ON NF-226
NEXT ASSEMBLY A110460-02
TITLE HARNESS

1 2 TC	DATE	7 CC	9 PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
		A2	10462-02		A	HARNESS	010	E	6	0001			361	3	10460-02	5
		31	10100262			WIRE, #20 RED	030	F	7	0001			361	4	10462-02	5
		31	10100263			WIRE, #20 BLU	030	F	7	0001			361	4	10462-02	5
		31	10101672			WIRE, #24 BRN	020	F	7	0001			361	4	10462-02	5
		31	10101674			WIRE, #24 YEL	020	F	7	0001			361	4	10462-02	5
		31	10101675			WIRE, #24 ORG	020	F	7	0001			361	4	10462-02	5
		31	10101676			WIRE, #24 BLU	020	F	7	0001			361	4	10462-02	5
		31	10101677			WIRE, #24 VIO	010	F	7	0001			361	4	10462-02	5
		31	10101678			WIRE, #24 GRY	010	F	7	0001			361	4	10462-02	5
		31	10101679			WIRE, #24 WHT	010	F	7	0001			361	4	10462-02	5
		31	10101680			WIRE, #24 BLK	020	F	7	0001			361	4	10462-02	5
		31	10101681			WIRE, #24 RED	020	F	7	0001			361	4	10462-02	5
		41	10100236			WRAP, TIE	500	E	7	0001			361	4	10462-02	5
		41	10101621			CONN	010	E	7	0001			361	4	10462-02	5
		41	10101055			CONN	010	E	7	0001			361	4	10462-02	5
		41	10102073			CONN	010	E	7	0001			361	4	10462-02	5

INTEGRA
ENGINEERING PARTS LIST

ASSEMBLY # A210389-01
USED ON NF-226
NEXT ASSEMBLY A110460-02
TITLE 488 PADDLE BOARD

1 2 TC	DATE	7 CC	9 PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
		A2	10389-01			CONN SWITCH BD	010	E	C	0001			362	3	10460-02	5
		25	10101819			PCB	010	E	7	0001			362	4	10389-01	5
		31	10101813			RIBBON CABLE	190	I	7	0001			362	4	10389-01	5
		41	10101149			STANDOFF KIT	010	E	7	0001			362	4	10389-01	5
		41	10101816			CONN, 26 PIN FEMALE	010	E	7	0001			362	4	10389-01	5
		41	10101817			488 CONNECTOR	010	E	7	0001			362	4	10389-01	5
		41	10101814			PADDLE BD CONN	010	E	7	0001			362	4	10389-01	5
		41	10101852			SWITCH	010	E	7	0001			362	4	10389-01	5

INTEGRA [illegible]
ENGINEERING PARTS LIST

ASSEMBLY # A210390-04
USED ON NF-226
NEXT ASSEMBLY A210467-03
TITLE IEEE 488 INTERFACE BOARD

1 2 TC	DATE	7 9 CC	PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
A2		10390-04			C	IEEE 488 INT BD	010	E	C	0008			37	2	210467-03	5
13		10100088				C CER 0.01 UF	090	E	7	0008	C 1,3,4,6,16-20		37	3	10390-04	5
13		10100968				C MICA 24 PF	020	E	7	0008	C 21, 22		37	3	10390-04	5
13		10101900				C ELEC 10 UF	040	E	7	0008	C 2,5,7,23		37	3	10390-04	5
13		10101936				C ELEC 4.7 UF	020	E	7	0008	C 14,15		37	3	10390-04	5
14		10101958				CRYSTAL, 11.0596MHZ	010	E	7	0008	Y 1		37	3	10390-04	5
15		10100019				DIODE	010	E	7	0008	CR 11		37	3	10390-04	5
15		10101633				DIODE, 1N4004	040	E	7	0008	CR 3,4,5,12		37	3	10390-04	5
17		10100382				LED, RED	040	E	7	0008	CR 7-10		37	3	10390-04	5
19		10101967				IC, DAC-71-CCD-V	010	E	7	0008	IC 1		37	3	10390-04	5
19		10101891				IC, SN74LS00N	010	E	7	0008	IC 6		37	3	10390-04	5
19		10101933				IC, 74LS138	010	E	7	0008	IC 7		37	3	10390-04	5
19		10101934				IC, 75161	010	E	7	0008	IC 19		37	3	10390-04	5
19		10101935				IC, 75160	010	E	7	0008	IC 20		37	3	10390-04	5
19		10101939				IC, 8039-L	010	E	7	0008	IC 8		37	3	10390-04	5
19		10101940				IC, 74LS373	010	E	7	0008	IC 18		37	3	10390-04	5
19		10101941				IC, 2716	010	E	7	0008			37	3	10435-01	5
19		10101942				IC, TMS9914NL	010	E	7	0008	IC 16		37	3	10390-04	5
19		10101943				IC, 74LS86	010	E	7	0008	IC 15		37	3	10390-04	5
19		10101944				IC, 74LS74	010	E	7	0008	IC 14		37	3	10390-04	5
19		10101945				IC, 8243	030	E	7	0008	IC 9,10,13		37	3	10390-04	5
19		10435-01				IC, PROM 8K	010	E	3	0008	IC 17		37	3	10390-04	5
25		10101837			A	PCB	010	E	7	0008			37	3	10390-04	5
27		10100110				R CARB 10K	090	E	7	0008	R 5,6,11-14		37	3	10390-04	5
27		10100225				R CARB 33K	010	E	7	0008	R 27		37	3	10390-04	5
27		10100303				R CARB 510K	010	E	7	0008	R 1		37	3	10390-04	5
27		10100304				R CARB 1K	010	E	7	0008	R 28		37	3	10390-04	5
27		10100411				R CARB 3.3M	010	E	7	0008	R 3		37	3	10390-04	5
27		10101937				R CARB 160	040	E	7	0008	R 29-32		37	3	10390-04	5
27		10101938				R SIP 33K	010	E	7	0008	RP 1		37	3	10390-04	5
28		10100321				R VAR 50K	020	E	7	0008	R 2,4		37	3	10390-04	5
30		10100095				TRANS, 2N4126	030	E	7	0008	Q 1,3,4		37	3	10390-04	5
31		10101675				WIRE, 24 AWG GRN	080	I	7	0008			37	3	10390-04	5
31		10101680				WIRE, 24 AWG BLK	080	I	7	0008			37	3	10390-04	5
41		10100084				SOCKET, 14 PIN	030	E	7	0008			37	3	10390-04	5
41		10100085				SOCKET, 40	020	E	7	0008			37	3	10390-04	5
41		10100128				SOCKET, 16 PIN	010	E	7	0008			37	3	10390-04	5
41		10100131				SOCKET, 24 PIN	050	E	7	0008			37	3	10390-04	5
41		10101809				TERMINAL	020	E	7	0008	TP 1,2		37	3	10390-04	5
41		10101122				SOCKET, 20 PIN	030	E	7	0008			37	3	10390-04	5
41		10101623				CONN, 2 PIN	020	E	7	0008			37	3	10390-04	5
41		10101624				CONN, 2 PIN	010	E	7	0008	J 4		37	3	10390-04	5
41		10101625				CONN, 16 PIN	010	E	7	0008	J 2		37	3	10390-04	5
41		10101815				CONN, 26 PIN	010	E	7	0008	J 3		37	3	10390-04	5

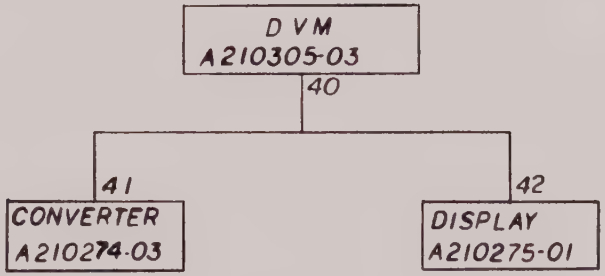
DWG. NO.	SH	REV.

REVISIONS

REV.	DESCRIPTION	DATE	APPROVED

LEVEL 1

LEVEL 2



QTY REQD	FSCM NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

	NF-XXX
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO

APPROVALS	DATE
DRAWN D M	9-17-81
CHECKED	
ISSUED Dennis Edmond	9-21-81

INTEGRA

PRODUCT STRUCTURE

SIZE	FSCM NO.	DWG. NO.	REV.
B	51162	B710305-03	A

SCALE | SHEET

BISHOP GRAPHICS, INC.
REORDER NO 20510

INTEGRA
ENGINEERI PARTS LIST

ASSEMBLY # A210305-03
USED ON NF-226
NEXT ASSEMBLY END ITEM
TITLE DVM

1 2 TC DATE	7 CC	9 PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
	A2	10305-03			DVM	010	E	C	0001			00	0	END ITEM	5
	41	10101220			ENCLOSURE	010	E	7	0001			00	1	10305-03	5
	41	10101631			ACRYLIC SHEET	020	C	7	0001			00	1	10101689	5
	41	10101619			LABEL, S/N	010	E	7	0001			00	1	10305-03	5
	41	10101689			LENS, RED POLARIZED	010	E	3	0001			00	1	10305-03	5

INTEGRA
ENGINEERIN - PARTS LIST

ASSEMBLY # A210274-03
USED ON NF-226
NEXT ASSEMBLY A210305-03
TITLE CONVERTER BOARD

1 2 TC	DATE	7 9 CC	PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATION	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
		A2	10274-03		B	CONVERTER	010	E	C	0001			10	1	10305-03	5
		13	10101367			C FILM .22 UF	010	E	7	0001	C 4		10	2	10274-03	5
		13	10101369			C CER .001 UF	010	E	7	0001	C 3		10	2	10274-03	5
		13	10101370			C CER .01 UF	010	E	7	0001	C 1		10	2	10274-03	5
		13	10101371			C CER 100 PF	010	E	7	0001	C 6		10	2	10274-03	5
		13	10101900			C ELEC 10 UF	010	E	7	0001	C 9		10	2	10274-03	5
		13	10101905			C ELEC 22 UF	030	E	7	0001	C 7,8,10		10	2	10274-03	5
		13	10101953			C ELEC 1 UF	020	E	7	0001	C 2,5		10	2	10274-03	5
		15	10100019			DIODE, IN4148	020	E	7	0001	CR 1,2		10	2	10274-03	5
		19	10100243			IC, CD4049AE	010	E	7	0001	IC 3		10	2	10274-03	5
		19	10100630			IC, SN7447N	010	E	7	0001	IC 4		10	2	10274-03	5
		19	10100837			IC, ICL7103ACD1	010	E	7	0001	IC 1		10	2	10274-03	5
		19	10100851			IC, ICL8052CPD	010	E	7	0001	IC 2		10	2	10274-03	5
		25	10101357		A	PCB	010	E	7	0001			10	2	10274-03	5
		27	10100439			R MF 24.9K	010	E	7	0001	R 1		10	2	10274-03	5
		27	10100440			R MF 6.19K	010	E	7	0001	R 2		10	2	10274-03	5
		27	10100309			R CARB 100K	020	E	7	0001	R 3,19		10	2	10274-03	5
		27	10100313			R CARB 2.7	020	E	7	0001	R 22,23		10	2	10274-03	5
		27	10100522			R MF 4.7K	010	E	7	0001	R 5		10	2	10274-03	5
		27	10100592			R MF 4.22K	010	E	7	0001	R 17		10	2	10274-03	5
		27	10100608			R MF 5.62K	010	E	7	0001	R 14		10	2	10274-03	5
		27	10101333			R CARB 300K	010	E	7	0001	R 16		10	2	10274-03	5
		27	10101362			R CARB 36K	010	E	7	0001	R 15		10	2	10274-03	5
		27	10101363			R CARB 30K	010	E	7	0001	R 21		10	2	10274-03	5
		27	10101364			R CARB 12K	010	E	7	0001	R 20		10	2	10274-03	5
		27	10101365			R CARB 47	040	E	7	0001	R 4,6,24,25		10	2	10274-03	5
		27	10101366			R CARB 22	070	E	7	0001	R 7-13		10	2	10274-03	5
		28	10100315			R VAR 500 10T	010	E	7	0001	R 18		10	2	10274-03	5
		30	10100092			TRANS, 2N4124	060	E	7	0001	Q 1-6		10	2	10274-03	5
		41	10100084			SOCKET 14 PIN	010	E	7	0001			10	2	10274-03	5
		41	10100128			SOCKET 16 PIN	020	E	7	0001			10	2	10274-03	5
		41	10101286			SOCKET 28 PIN	010	E	7	0001			10	2	10274-03	5

INTEGRA
ENGINEERING PARTS LIST

ASSEMBLY # A210275-01
USED ON NF-226
NEXT ASSEMBLY A210305-03
TITLE DISPLAY BOARD

1 2 TC	DATE	7 CC	9 PART NUMBER	17 SUFF	18 REV	19 DESCRIPTION	40 QUA	43 U/M	44 SRC	45 E/F	REF DESIGNATIONS	63 M	64 T/P	70 L	71 NEXT ASSY	80 C
		A2	10275-01			DISPLAY BD	010	E	C	0001			20	1	10305-03	5
		17	10101057			LED, 5082-7730	040	E	7	0001	DI 1-4		20	2	10275-01	5
		17	10101349			LED, 5082-7736	010	E	7	0001	DI 5		20	2	10275-01	5
		25	10101358			PCB	010	E	7	0001			20	2	10275-01	5